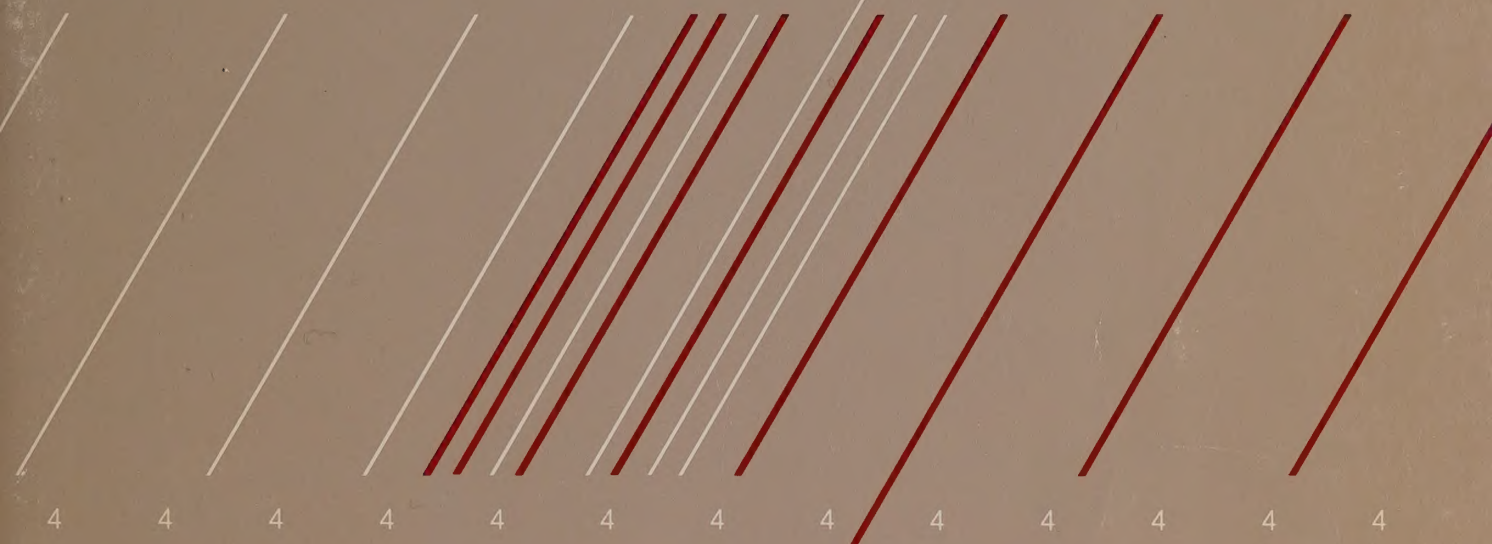
The Ontario Task Force on Employment and New Technology



Employment and New Technology in Ontario's Manufacturing Sector: a Summary of Selected Industries

An Appendix to the Final Report

ONTARIO TASK FORCE ON EMPLOYMENT AND NEW TECHNOLOGY

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FOREWORD

The Ontario Task Force on Employment and New Technology, a joint labour-management group, was established in May 1984 "to consider and report on the manpower and employment implications of new technologies as the same may be introduced and applied in Ontario during the next decade and the extent and nature thereof."

To inform its discussions, the Task Force established a research agenda designed to gather information on employment and technological change from a wide variety of sources. The research agenda contained projects which gathered information of a historical nature, and projects with a future orientation which were designed to gather information describing likely occupational and employment implications associated with technological change in the 1985-1995 period.

The Appendices to the Final Report of the Ontario Task Force on Employment and New Technology contain reports of these research projects. A complete list of these Appendices may be found at the rear of this document.

Among the Appendices are reports of a series of studies to assess the extent and nature of the employment implications of new technology in selected industries in Ontario. Appendix 3 describes the process by which the industries were selected, and contains the studies' terms of reference which called for particular attention to selected new technologies and occupational groups. Appendices 4-18 contain reports of these industry studies, which were conducted by Currie, Coopers & Lybrand, management consultants.

This particular appendix contains a summary of results obtained from the industries which were selected for study in the manufacturing sector.

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Research Director

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Special thanks are due to all industry experts and survey respondents who provided information for this study.

EMPLOYMENT AND NEW TECHNOLOGY IN ONTARIO'S MANUFACTURING SECTOR: A SUMMARY OF SELECTED INDUSTRIES

A Report Prepared by Currie, Coopers & Lybrand
for the Consideration of the Ontario Task Force
on Employment and New Technology

July, 1985

Submitted by: Maureen Farrow
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TABLE OF CONTENTS

TABLE OF CONTENTS
(Cont'd)

LIST OF EXHIBITS

LIST OF TABLES

LIST OF TABLES (Cont'd)

EMPLOYMENT AND NEW TECHNOLOGY IN ONTARIO'S MANUFACTURING SECTOR: A SUMMARY OF SELECTED INDUSTRIES

1.0 INTRODUCTION

This report is one of a series of industry reports which summarize the findings of a major research project[1] undertaken for the Ontario Task Force on Employment and New Technology. The report summarizes the results of the investigation into selected industries in Ontario's manufacturing sector which are:

Industry	Standard Industrial Classification (2)
Iron and Steel	SIC 291
Metal Fabricating	SIC 304, 306, 309
Miscellaneous Machinery and Equipment	SIC 315
Office, Store and Business Machinery	SIC 318
Aircraft and Aircraft Parts	SIC 321
Communications Equipment	SIC 335
Plastics Processing	SIC 165

1.1 Structure of This Report

This report includes four parts:

- The first part (Chapter 1.0) is this Introduction which includes a description of the approach and methodology.

- The second part (Chapter 2.0) summarizes key aspects of the historical reports prepared for each industry from 1971 to 1982 on which more detail can be found in the specific industry reports (Appendices 5 to 11).

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[1] Manpower and Employment Implications of New Technologies in Selected Manufacturing Industries in Ontario to 1995. The terms of reference of this assignment can be found in Appendix 3 to the Task Force's final report.

[2] 1970, Standard Industrial Classification (SIC), Statistics Canada.

- The third part (Chapters 3.0 to 7.0) discusses the results of the survey of firms in each industry and incorporates the discussions with the industry experts. These chapters cover:

  - a review of output and employment in each of the selected industries from 1971 to 1982,

  - a review of recent and anticipated technology adoptions in each industry,

  - the outlook for each industry to 1995, including expected output and employment levels,

  - effects on employment of new technology such as anticipated occupational shifts and changes in required skills,

  - an overview of the labour relations environment as it relates to new technology, and

  - observations on planning efforts for technological change by industry.

- Part four of the report includes various appendices that support the text of individual chapters.

1.2 Study Approach

The study approach selected incorporates the following research techniques:

- analysis of published statistics and reports on the industry, augmented by the working knowledge of industry specialists within Currie, Coopers & Lybrand,

- in-depth interviews with management and labour experts in each industry, conducted at various stages in the project using structured interview guides, and

- a survey of each industry.

The reasons for the choice of these techniques are explained below.

1.2.1 Historical Analysis

The purpose of the historical analysis was to provide an informed perspective for each industry from which to view future trends. The historical analysis covers: the economic environment, competitive factors, output and employment patterns, productivity, technology adoption and the industrial relations environment. In order to permit cross-industry analysis, consistent indicators and data sources were used. The historical analysis summarized in this summary report, however, focuses on two key indicators: manufacturing shipments and employment in Ontario.

1.2.2 Expert Interviews

At various stages in the project a series of in-depth interviews were conducted with industry leaders, industry associations and union representatives. These experts had a broad understanding of their respective industries in terms of both historical development and future outlook. Their input assisted in the preparation of the historical analysis and in the survey design, and facilitated a clearer interpretation of the survey results.

TABLE 1: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

SIC Code	SIC NAME	SAMPLE FRAME AND SAMPLE										
		UNIVERSE		SAMPLE FRAME				SAMPLE				
		Number of Firms	Number of Employees(1)	Firm Size Cut Off	Number of Firms	Number of Employees(2)	Share of Universe	Number of Firms	Number of Unions	Number of Employees(3)	Reliability Level (min.)	Degree of Error
												Percent
291	Iron and Steel Mills	17	41,603	500	7	39,900	96	3	1	21,833	90	23
304	Metal Stamping, Pressing and Coating Industry	185	17,730	20	145	17,200	97	14	3	4,507	99	5
306	Hardware, Tool and Cutlery Manufacturing	225	12,826	20	135	11,500	90	11	6	1,489	94	5
309	Miscellaneous Metal Fabricating Industries	132	12,235	20	110	12,000	98	11	6	2,694	99	5
315	Miscellaneous Machinery and Equipment Manufacturers	304	36,904	20	262	36,500	99	12	3	3,972	99	5
318	Office and Store Machinery Manufacturers	29	10,485	20	29	9,800	93	7	0	11,814	99	5
335	Communications Equipment Manufacturers	67	28,090	20	65	27,800	99	12	2	14,946	90	11
321	Aircraft and Aircraft Parts Manufacturers	22	12,732	50	17	12,000	94	10	5	11,737	95	7
165	Plastic Processing	196	19,218	20	169	18,800	98	13	4	2,400	99	5

(1) Source: Census of Manufacturing, 1982, Statistics Canada, Catalogue No. 31-203.

(2) Rounded to nearest 100.

(3) Sum of firms' estimates for 1984, rounded to nearest 100.

1.2.3 Sample Survey of Firms

The following describes the key features of the sample survey.

Ontario firms in the selected manufacturing industries were identified using the 1982 Census of Manufacturers.[1] For most industries, firms with twenty (20) or more employees were included in the sample frame. Exceptions were Iron and Steel (SIC 291) in which only firms with 500 or more employees were considered and Aircraft and Aircraft Parts (SIC 321) in which only firms with 50 or more employees were considered (See Table 1).

A representative, random sample of firms, stratified by employment size categories (see Appendix A for categories), was chosen. The senior executive officer of each firm was identified and a structured questionnaire was sent to this individual.

A search was carried out of the Ontario Ministry of Labour Collective Agreements Library to identify unions in the sample firms. Union head offices were contacted to identify the appropriate union leader in each of the unionized firms in the sample. The same questionnaire was sent to union representatives. A copy of the survey questionnaire is attached to each of the individual industry reports.

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1 Manufacturing Industries of Canada: National and Provincial Areas, 1982, Statistics Canada, Catalogue No. 31-203. The number of firms should not be confused with the number of establishments. Establishments are production centres. Therefore, one firm may be comprised of more than one establishment.

TABLE 2: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Average Number of Participants per Questionnaire and Experience of Participants

SIC	Industry	Firms			Unions		
		Average Number of Participants per Questionnaire	Average Years in Firm	Average Years in Industry	Average Number of Participants per Questionnaire	Average Years in Firm	Average Years in Industry
291	Iron and Steel	1.7	19	19	1.0	7	7
304	Metal Coating and Stamping Industry	1.9	18	23	1.0	16	16
306	Hardware, Tool and Cutlery Manufacturing	2.4	22	22	1.8	12	17
309	Miscellaneous Metal Fabricating Industries	1.1	9	23	1.0	18	16
315	Miscellaneous Machinery and Equipment Manufacturers	1.1	15	22	1.0	20	20
318	Office and Store Machinery Manufacturers	1.3	18	27	n.a.	n.a.	n.a.
335	Communications Equipment Manufacturers	2.8	9	19	1.0	20	20
321	Aircraft and Aircraft Parts Manufacturers	1.0	14	11	1.0	25	26
165	Plastic/Processing	1.7	13	18	1.3	16	16
	Average of Reporting Firms	1.1	16	20	1.0	16	18

n.a. - not applicable

Consultants provided ongoing assistance to respondents, both on the telephone and in person, to complete the questionnaires. The questionnaire survey process generally ended with a personal interview. The number of firms and unions who participated in the sample survey are shown in Table 1.

In most cases, several participants in each organization contributed to the completion of a questionnaire (see Table 2). For all manufacturing industries surveyed, an average of 1.1 participants contributed to a firm questionnaire and one participant to a union questionnaire. The companies' principal participants had an average of 16 years' experience with their firms and 20 years in their respective industry. The unions' principal participants had an average of 16 years with their firms and 18 years in the industry. Table 2 shows these characteristics of respondents by industry.

The sample survey results have been weighted up to the number of firms in the sample frame. That is, the survey results reported herein refer to the weighted survey results and are, therefore, representative of the sample frame for each industry in Ontario. The reliability of the sample and the degree of error are noted in Table 1. See Appendix B for an explanation of the sample reliability calculation method.

The responses from union participants are reported herein as unweighted data. Discussion of the union survey results focuses on issues related to the labour relations environment found in Chapter 6.0. Union responses on other aspects of the survey were too incomplete to be reported.

Readers should, however, be cautioned about the nature and reliability of the sample survey results. The questionnaire included a set of questions asking respondents about the future (i.e., five and ten years ahead) from a particular point in time. The results are, therefore, a representative sample of views about and expectations for the future and should not be viewed as what will necessarily take place. The survey provides a useful perspective from which to better understand how the industries studied in the manufacturing sector view the future of new technology adoption and its anticipated impacts on employment.

The next chapter of the report discusses the historical output and employment of each industry from 1971 to 1982. Subsequent chapters review the results of the sample survey and expert consultation which discuss the anticipated trends for the period 1985 to 1995.

2.0 HISTORICAL ANALYSIS

This chapter of the report provides an overview of the historical performance of the selected manufacturing industries investigated from 1971 to 1982. Two key indicators are used: value of manufacturing shipments and employment in Ontario. These indicators have been selected as they illustrate the level of economic activity and the associated employment trends.

2.1 Aggregate Output

In 1982, the nine industries under review accounted for $16.4 billion in value of manufacturing shipments in Ontario or 17.4% of the total for all manufacturing industries that year. Table 3 shows the value of shipments for the nine industries in 1971 and 1982, in both current and constant (1971) dollars, along with the percentage change over this period in terms of both current and constant dollars. The aggregate output of the nine industries as a group as a percentage of the total manufacturing shipments from 1971 to 1982 remained about the same in Ontario (18.1% in 1971 to 17.4% in 1982 as measured in current dollars, or 18.8% in 1982 as measured in constant 1971 dollars).

Looking at the percentage change in constant dollars, the output of three industries has grown much more rapidly than the average for all manufacturing industries (23.8%) during this period. These fast growth industries are Office and Store Machinery (63.2%), Communications Equipment (128.6%) and Plastics (100.6%). The output of the remaining industries has grown more slowly than the average for the nine industries under study and the average for all manufacturing industries from 1971 to 1982.

TABLE 3: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

SIC	Industry	MANUFACTURING SHIPMENTS IN ONTARIO (In Millions of Dollars) 1971 Current	1982 Current	1982 Constant* ($ 1971)	Percent (%) Change 1971-1982 Current Dollars	Percent (%) Change 1971-1982 Constant Dollars
291	Iron and Steel	$1,394.5	$4,691.9	$1,493.3	236.5%	7.1%
304	Metal Stamping, Pressing and Coating	616.8	1,786.5	643.1	189.6	4.3
306	Hardware, Tool and Cutlery	201.3	736.4	248.8	265.8	23.6
309	Miscellaneous Metal Fabricating	374.2	1,042.0	375.1	178.5	0.2
315	Miscellaneous Machinery and Equipment	957.3	3,091.9	1,118.6	123.0	16.8
318	Office and Store Machinery	198.1	823.2	323.3	315.5	63.2
335	Communications Equipment	426.9	1,819.2	976.0	326.1	128.6
321	Aircraft and Aircraft Parts	253.0	835.5	289.3	230.2	14.3
165	Plastic Processing	325.9	1,533.3	653.9	370.5	100.6
Sub-Total, Selected Industries		$4,748.0	$16,359.9	$6,121.4	244.6%	28.9%
TOTAL, All Manufacturing Industries		$26,270.6	$93,939.3	$32,527.5	257.6%	23.8%
Selected Industries as a % of Total		18.1%	17.4%	18.8%		

* Current dollar value of Manufacturing Shipments deflated by respective Industry Selling Price Index.

Table 4 provides several measurements of manufacturing activity including each industry's share of total manufacturing shipments in 1971, 1981 and 1982, and compound annual growth rates for each industry for the periods 1971 to 1976, 1976 to 1981, and 1981 to 1982. As might be expected, Table 4 shows that, between 1971 and 1982, the three fast growth industries identified above increased their respective share of total manufacturing shipments in Ontario (Office and Store Machinery - 0.8% to 0.9%, Communications Equipment - 1.6% to 1.9%, and Plastics Fabricating - 1.2% to 1.6%). During the same period, the respective share of total manufacturing shipments in Ontario for the other manufacturing industries under study remained the same, or declined. All of these industries followed closely the business cycle during the 1970's and early 1980's. These cyclical patterns may be briefly described as:

- strong growth in the early 1970's with a cyclical peak in 1974,

- a cyclical downturn in 1974-1975, reflecting the economic recession which was largely driven by the first oil price shock.

- a steady recovery from 1976 to 1979 with many industries' output peaking in 1979,

- the start of a severe and long recessionary period in 1980 to 1982 with a number of industries still, to this date, not fully recovering to their 1978-1979 production levels and many with weak, near-term prospects.

TABLE 4: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

SIC	Industry	MANUFACTURING SHIPMENTS IN ONTARIO: Share of Total Industry Manufacturing Shipments in Ontario Percent (%) 1971	1981	1982	1982 Current $ ($ million)	Annual Compound Rates of Change in Constant* (1971) Dollars Percent (%) 1971-76	1976-81	1981-82
291	Iron and Steel	5.3%	6.0%	5.0%	$4,691.9	2.9%	3.7%	-22.7%
304	Metal Stamping, Pressing and Coating	2.3	2.1	1.9	1,786.5	2.0	2.5	-16.5
306	Hardware, Tool and Cutlery	0.8	0.8	0.8	736.4	7.6	-1.0	- 9.8
309	Miscellaneous Metal Fabricating	1.4	1.2	1.1	1,042.0	3.9	-0.4	-15.4
315	Miscellaneous Machinery and Equipment	3.6	3.8	3.3	3,091.9	0.8	7.2	-20.4
318	Office and Store Machinery	0.8	0.9	0.9	823.2	2.9	8.5	- 5.8
335	Communications Equipment	1.6	1.8	1.9	1,819.2	(1971-78)** 5.1	(1978-81) 16.2	2.7
321	Aircraft and Aircraft Parts	1.0	1.1	0.9	835.5	-6.3	14.7	-20.2
165	Plastic Processing	1.2	1.6	1.6	1,533.3	8.3	7.3	- 5.4

* Current dollar value of manufacturing shipments deflated by respective Industry Selling Price Index.

** Data unavailable in constant dollars for 1976.

The metal based industries (SIC 291, 304, 306, 309) generally followed the same broad cyclical path. Particular trends to note are:

- the strong growth of the Iron and Steel industry during the mid-1970's,

- the strong performance of the Hardware, Tool and Cutlery industry during the first half of the 1970's followed by a steady decline since, and

- the strong performance of the Miscellaneous Metal Fabricating industry during the first half of the 1970's.

All of the metal-based industries were adversely affected by the 1981-1982 recession and, in general, have not yet experienced much of a recovery.

In contrast, strong growth was shown in Miscellaneous Machinery and Equipment, Communications Equipment, Office and Store Machinery, and Aircraft industries in the second half of the 1970's, compared to the first half of the decade. The Plastics Fabricating industry demonstrated strong, steady growth throughout the decade with downturns occurring during the oil shocks in 1974-1975 and 1979-1980 periods.

During the 1981 to 1982 period, the metal-based industries, as already indicated, were hardest hit by the recession. Table 4 demonstrates the impact of the recession on the metal-based industries (including Miscellaneous Machinery and Equipment) when all of these declined dramatically in output from 1981 to 1982 and their respective share of total manufacturing shipments also declined sharply. For example, Iron and Steel declined from 6.0% in 1981 to 5.0% in 1982 in its share of total manufacturing

EXHIBIT 1

SELECTED MANUFACTURING INDUSTRIES: AGGREGATE OUTPUT AND MAJOR MARKET FACTORS

SIC	INDUSTRY	1971 TO 1976	1976 TO 1981	1981 TO 1982
291	IRON AND STEEL	Capacity expansion in mid-1970's to meet the growth in domestic consumption, import replacement, and growth in exports. Growth especially in specialty steels. Movement toward further vertical integration of major producers.	Highly competitive; international market. Developing countries expand capacity. World-wide over capacity. Mini-mills, using scrap, are most efficient mills. Vertical integration has become a disadvantage.	Hard hit by recession.
	METAL FABRICATING	Strong demand 1971 to 1974. Reduced demand 1974 to 1975. Strong cyclical expansion 1975 to 1980. Industry serves a wide variety of markets. Key industries: auto; construction; energy.		Hard hit by recession.
304	Stamping, Pressing and Coating	SIC 304 has 50% of Metal Fabricating shipments. Strong growth for sectors serving energy mega projects. Auto sector key: dependent on U.S. auto imports, adversely hit by small car imports.		Markets hit by severe recession.
306	Hardware, Tool and Cutlery	SIC 306 has 20% of Metal Fabricating shipments. Strong growth in early 1970's. Downturn 1975 to 1977. Regains in 1978; peak in 1979.		Recession related.
309	Miscellaneous Metal Fabricating	SIC 309 has 30% of Metal Fabricating shipments. Strong growth in early 1970's. 1975 downturn. Peak in 1978. General decline 1979 to 1981.		Recession - low capital spending.
315	MISCELLANEOUS MACHINERY AND EQUIPMENT	Slow growth in early 1970's. International markets - small domestic market. Highly competitive. Quality is key factor. Japan and W. Germany challenge U.S.A.	Strong growth in late 1970's: energy mega projects and strong machinery and equipment investment. Developing countries start to export; price-critical; challenge to traditional leaders.	Hard hit by recession. Excess capacity world-wide. Hit hard by slump in energy exploration and severe decline in capital spending.
318	OFFICE AND STORE MACHINERY	Influence of microchip throughout decade. Adaptors do well; traditional products poorly. Computer industry driven by move from mainframe to micro to mini. Microchip lowers cost, opening new markets. Steady decline in costs of information technology. Word processing and point of sale scanning units show strong steady growth		Recession dampened growth. Strong recovery IBM reinforces leader position.
335	COMMUNICATIONS EQUIPMENT	Heavily influenced by developments. in microchip technology.	Technology driven industry. Deregulation in 1979 opens new Canadian markets. Convergence of technology: office equipment, data processing and communications. Canadian majors move into international market. Developing countries offer large new markets.	Growth dampened. Strong recovery Increasingly competitive. Northern Telecom maintains industry leader position; increasingly expands production to Third World.
321	AIRCRAFT AND AIRCRAFT PARTS	General contraction of Canadian industry, 1971-1976. Small domestic market.	1977 to 1981: strong growth. World scale markets. Canada focuses on market niches. Increased competition and high R&D costs produces consolidation. Increased collaborative ventures. Defense spending is major driver.	Recession contracts air travel and demand for domestic aircraft.
165	PLASTICS PROCESSING	Strong steady growth. Downturns in 1974-1975 and 1979-1980 due to business cycles and oil shocks. Plastics is highly attractive substitute for other materials. Constantly finding new uses/new markets. Rising feedstock costs. Some markets mature.		Recession reduces demand. Good recovery. Plentiful supply of resins (feedstock).

shipments. Communications Equipment, Office and Store Machinery and Plastics have demonstrated strong recovery since 1982, while Aircraft has faired less well.

Exhibit 1 highlights key cyclical patterns in the selected manufacturing industries and major environmental factors affecting each industry for the period 1971 to 1982. Further detail is provided in the specific industry reports.

2.2 Employment

In 1982, total employment in the nine selected manufacturing industries was 191,823, representing 22.6% of all manufacturing employment in Ontario. The 1982 employment level represents an increase of 13.6% over the 1971 level of 168,792. This rate of employment growth was more than twice that for all manufacturing industries in Ontario during this period (6.0%).

Table 5 shows the employment level of each of the selected industries from 1971 to 1982 and the percentage change during the period. Employment growth in five industries exceeds the average for the group: Hardware, Tool and Cutlery (20.8%), Office, Store and Machinery (52.4%), Communications Equipment (21.8%), Aircraft (14.8%) and Plastics (43.8%). Two industries had positive employment growth exceeding the average for all manufacturing industries in Ontario: Iron and Steel (9.4%) and Miscellaneous Machinery and Equipment (9.4%), while employment in the remaining two industries actually declined: Metal Stamping and Coating (-4.0%) and Miscellaneous Metal Fabricating (-9.6%). As a whole, the rate of employment growth in the non-metal-based industries exceeded substantially that of the metal-based industries.

TABLE 5: SUMMARY - SELECTED MANUFACTURING EMPLOYMENT

SIC	Industry	EMPLOYMENT IN ONTARIO Level 1971	Level 1982	Percent (%) Change 1971 to 1982
291	Iron and Steel	38,037	41,603	9.4%
304	Metal Stamping, Pressing and Coating	18,478	17,730	-4.0
306	Hardware, Tool and Cutlery	10,621	12,826	20.8
309	Miscellaneous Metal Fabricating	13,532	12,235	-9.6
315	Miscellaneous Machinery and Equipment	33,738	36,904	9.4
318	Office and Store Machinery	6,878	10,485	52.4
335	Communications Equipment	23,057	28,090	21.8
321	Aircraft and Aircraft Parts	11,091	12,732	14.8
165	Plastic Processing	13,360	19,218	43.8
Sub-total, Selected Industries		168,792	191,823	13.6%
Total, All Manufacturing Industries		800,047	848,403	6.0%

Table 6 shows, for each of the selected manufacturing industries, industry employment as a share of total manufacturing employment for the years 1971, 1981 and 1982, and growth rates for the periods 1971 to 1976, 1976 to 1981, and 1981 to 1982. It shows that the rate of employment growth varies substantially over these three periods of time. Sharp declines in employment were experienced in seven of the nine industries for the year 1981 to 1982, highlighting the impact of the recession on employment levels. The only two industries showing employment increases in 1981 to 1982 are Office and Store Machinery (3.0%) and Communications Equipment (0.1%).

Table 7 compares actual jobs created from 1971 to 1981, 1981 to 1982, and 1971 to 1982 as compared to rates of change. Table 7 also comments on each industry in terms of:

- its relative share of total manufacturing jobs from 1971 to 1981, (i.e., job creators or losers), and

- its ability to sustain jobs during the 1981-82 recession relative to declines in output (i.e., job sustainers).

In terms of actual jobs created 1971 to 1982, the major job creators were the Plastics (5,858) and Communications Equipment (5,033) industries, followed by Office and Store Machinery (3,607), Steel (3,566), Miscellaneous Equipment (3,166), Hardware (2,205) and Aircraft (1,641). Metal Stamping and Miscellaneous Metal Fabricating lost 784 and 1,297 jobs, respectively.

2.3 Conclusion

Using the historical data on Tables 4 and 6 to compare each industry's share of total manufacturing output, as measured by value of shipments, and employment in 1971 and 1981, Table 8

TABLE 6: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

SIC	Industry	EMPLOYMENT IN ONTARIO						
		Share of Total Ontario Manufacturing Jobs Percent (%)			1982 Employment Level	Annual Compound Rates of Change Percent (%)		
		1971	1981	1982		1971-76	1976-81	1981-82
291	Iron and Steel	4.8%	4.7%	4.9%	41,603	1.2%	1.3%	- 3.0%
304	Metal Stamping, Pressing and Coating	2.3	2.1	2.1	17,730	1.7	1.1	- 7.0
306	Hardware, Tool and Cutlery	1.3	1.5	1.5	12,826	5.6	-0.1	- 7.7
309	Miscellaneous Metal Fabricating	1.7	1.6	1.4	12,235	3.3	-1.6	-16.7
315	Miscellaneous Machinery and Equipment	4.2	4.6	4.3	36,904	0.6	3.8	-12.0
318	Office and Store Machinery	0.9	1.1	1.2	10,485	-0.8	9.0	3.0
335	Communications Equipment	2.9	3.1	3.3	28,090	-0.1	4.1	0.1
321	Aircraft and Aircraft Parts	1.4	1.7	1.5	12,732	-6.4	14.6	-19.4
165	Plastic Processing	1.7	2.2	2.3	19,218	4.7	3.6	- 4.4
	Sub-Total	21.1%	22.7%	22.5%	191,823			

TABLE 7: SUMMARY - SELECTED MANUFACTURING INDUSTRIES: EMPLOYMENT PERFORMANCE 1971 TO 1982

SIC	Industry	New Job Creation 1971 to 1981	New Job Creation or Loss 1981 to 1982	Net Job Creation or Loss 1971 to 1982	
291	Iron and Steel	4,873	-1,307	3,566	Although it lost share it was a net job creator 1971 to 1981 and a relative job sustainer 1981 to 1982
304	Metal Stamping, Pressing & Coating	584	-1,332	-784	Job loser
306	Hardware, Tool & Cutlery	3,272	-1,067	2,205	Net job creator; share unchanged 1971 to 1981 and a relative job sustainer 1981 to 1982
309	Miscellaneous Metal Fabricating	1,161	-2,458	-1,297	Job loser
315	Miscellaneous Machinery and Equipment	8,215	-5,049	3,166	Relative job creator but not a job sustainer 1981 to 1982
318	Office and Store Machinery	3,298	309	3,607	Job creator
335	Communications Equipment	5,002	31	5,033	Job creator
321	Aircraft and Parts	4,709	-3,068	1,641	Net job creator but unstable
165	Plastic Processing	6,747	- 889	5,858	Strong job creator

categorizes each industry as an output and employment gainer (+) or 'loser' (-) during this period. The year 1981 was used to discount the cyclical effects of the 1982 recession. The table shows that the non-metal-based industries and Miscellaneous Machinery and Equipment have been clear gainers, while Metal Stamping, Pressing and Coating, and Miscellaneous Metal Fabricating have been clear losers. Iron and Steel and Hardware, Tool and Cutlery, as industries, have generally held their own.

TABLE 8: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

SIC	Industry	Change in Share of Total Manufacturing Output 1971-1981	Change in Share of Total Manufacturing Employment 1971-1981
291	Iron and Steel	+	-
304	Metal Stamping, Pressing and Coating	-	-
306	Hardware, Tool and Cutlery	o	+
309	Miscellaneous Metal Fabricating	-	-
315	Miscellaneous Machinery and Equipment	+	+
318	Office and Store Machinery	+	+
335	Communications Equipment	+	+
321	Aircraft & Aircraft Parts	+	+
165	Plastic Processing	+	+

+ increased share (i.e., 'gainer')
- decreased share (i.e., 'loser')
o no change in share

The next chapters summarize the industry survey results for the selected manufacturing industries.

3.0 ADOPTION OF NEW TECHNOLOGY

This chapter reports the expected trends in the adoption of new technologies in the selected manufacturing industries and the factors driving the need and affecting the rate of technology adoption. The discussion is based on the survey results and the expert consultation process.

3.1 New Technologies and Rates of Adoption

Table 9 summarizes the percentage of firms who adopted new technologies before 1985, or will by 1990, or will after 1990 and before 1995. Firms may have chosen more than one time period per technology. Generally, however, only one time period was selected.

Table 10, based on the survey data in Table 9, rates each industry by key representative technologies, as a technology leader (+), follower (o) or lagger (-). This rating is based on the firms' responses relative to the average for the nine industries investigated. Although some technologies are more applicable to certain industries than are others, this table provides a relative indication for each industry of the extent and rate of new technology adoption.

Based on survey data in Table 9 and the relative rating of each industry by key technology in Table 10, the industries surveyed may be categorized generally as a technology 'leader', 'follower' or 'lagger', as shown in Exhibit 2, below.

TABLE 9: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Percent of Firms Planning to Adopt New Technologies by Industry (1)

Technologies	SIC 291			SIC 304			SIC 306			SIC 309			SIC 315		
	Before 1985	1985-1990	1990-1995	Before 1985	1985-1990	1990-1995	Before 1985	1985-1990	1990-1995	Before 1985	1985-1990	1990-1995	Before 1985	1985-1990	1990-1995
1. DESIGN AND PRODUCT TECHNOLOGIES															
Computer-Aided Design (CAD)	0	100	-	7	14	7	0	59	41	44	44	11	2	50	20
Computer-Aided Engineering (CAE)	67	-	33	0	8	-	0	12	30	0	68	-	36	27	8
CAD/CAM Integration	0	-	67	7	7	13	0	50	61	14	51	-	1	21	44
Other Design Technologies	33	33	33	0	-	7	0	-	-	0	-	-	0	-	-
2. MANUFACTURING PLANNING AND CONTROL SYSTEMS															
Computerized Financial Systems	100	33	33	80	20	-	85	19	16	66	35	-	76	31	-
Computerized Order Entry/Inventory Control	100	33	33	51	36	14	54	46	18	48	64	-	76	31	-
Computer-Aided Process Planning	100	33	33	23	36	21	0	85	31	19	62	18	38	52	17
Manufacturing Resource Planning Systems (MRP)	0	100	33	20	26	15	9	33	19	38	62	23	9	66	17
Automated Shop Floor Data Collection	67	33	33	0	39	24	4	48	32	6	71	23	8	57	25
Computerized Decision Support Systems	33	67	33	0	44	31	5	52	19	31	50	29	1	41	40
Computerized Maintenance Planning and Control	67	100	33	0	67	33	0	38	19	1	51	48	1	56	25
Other				0	21	100									
3. MANUFACTURING PROCESS TECHNOLOGIES															
Ladle Metallurgy (SIC 291)	0	100	33												
Continuous Casting (SIC 291)	67	33	33												
Automatic Casting/Molding	0	33	-										24	22	2
Numerically Controlled CN Machines (NC)	67	67	33	25	7	7	91	27	-	57	13	-	51	37	9
Computer Controlled Machines (CNC)	0	100	33	18	20	18	54	54	18	50	32	1	32	44	20
CAD Directed CNC	0	33	33	0	7	7	16	46	66	0	44	16	1	35	38
Computerized Process Control Systems	67	67	33	27	21	100	9	48	19	44	24	-	22	30	1
Computer-Aided Inspection and Testing	67	100	33	21	31	21	4	58	35	1	70	-	9	30	25
Robotic Applications	0	-	67	0	41	34	12	17	6	29	46	28	0	53	10
Flexible Manufacturing Technologies				0	7	-	0	27	32	0	29	2	0	25	11
Computer Integrated Manufacturing (CIM)	0	33	-	0	20	7	18	27	32	0	2	-	1	14	25
Other													0	16	15
4. MATERIALS HANDLING TECHNOLOGIES															
Automatic Bulk Handlers/Feeder Systems	67	33	33	57	19	17	0	-	6	26	74	-	42	11	11
Automated Conveyor/Vehicle Systems	67	33	33	25	13	18	19	24	5	20	31	29	0	14	11
Automated Storage and Retrieval	0	33	67	0	13	-	0	5	24	0	1	49	0	14	-
Computer Controlled Conveyor/Vehicles	0	-	33	0	7	-	0	6	6	0	27	-	0	3	13
Automated Warehouse	33	33	33	0	13	7	0	5	24	0	-	2	0	-	2
Other	0	-	-	0	-	-	0	-	-	0	35	-	0	-	-
5. TELECOMMUNICATIONS TECHNOLOGIES															
Facsimile (FAX) Link: HO/Plant(s)	100	33	33	43	13	-	14	24	5	51	13	-	50	15	18
Computer Link: HO/Plant(s)	100	33	33	39	40	-	27	42	-	35	17	-	26	36	19
Computer Link: Suppliers/Customers	33	100	33	17	60	-	5	76	-	0	100	-	0	27	56
Other	0	33	-												
6. OTHER TECHNOLOGIES	33	67	33	7	20	-	19	19	-						

(1) '0' used prior to 1985 to indicate have not adopted. '-' used for periods 1985-1990 and 1990-1995 to indicate respondents, at the time of survey are not planning to adopt this technology or 'don't know'. Multiple responses accepted.

TABLE 9 : SUMMARY - SELECTED MANUFACTURING INDUSTRIES, Continued (1)

Percent of Firms Planning to Adopt New Techhologies by Industry

Technologies	SIC 318			SIC 335			SIC 321			SIC 165			Average of Reporting Firms		
	Before 1985	1985-1990	1990-1995	Before 1985	1985-1990	1990-1995	Before 1985	1985-1990	1990-1995	Before 1985	1985-1990	1990-1995	Before 1985	1985-1990	1990-1995
1. DESIGN AND PRODUCT TECHNOLOGIES															
Computer-Aided Design (CAD)	26	74	-	40	35	-	21	37	21	7	55	-	14	51	12
Computer-Aided Engineering (CAE)	26	74	-	74	6	-	21	37	21	7	31	31	24	28	15
CAD/CAM Integration	23	35	-	6	40	42	21	24	7	0	33	8	7	28	27
Other Design Technologies				8	-	-	13	7	-				7	5	5
Installed Micro Processors	79	21	-	47	-	-							72	11	100
Multi-Functional Machines	46	42	-										42	37	-
Other				6	-	-									
2. MANUFACTURING PLANNING AND CONTROL TECHNOLOGIES															
Computerized Financial Systems	46	33	-	83	13	-	79	24	-	87	13	-	79	23	5
Computerized Order Entry/Inventory Control	67	21	-	81	28	-	87	24	-	62	38	-	67	36	7
Computer-Aided Process Planning	5	62	-	23	41	6	38	72	-	49	27	6	33	53	15
Manufacturing Resource Planning Systems (MRP)	5	62	-	22	41	12	46	54	-	46	38	16	22	51	15
Automated Shop Floor Data Collection	5	21	-	25	39	24	28	72	7	6	68	27	15	52	23
Computerized Decision Support Systems	5	74	-	33	19	13	21	52	-	14	64	7	14	52	19
Computerized Maintenance Planning and Control	5	-	-	15	54	12	21	69		6	59	14	12	55	20
Other				6	-	-	10	-	-	0	10	-	2	4	-
3. MANUFACTURING PROCESS TECHNOLOGIES															
Ladle Metallurgy (SIC 291)													0	100	33
Continuous Casting (SIC 291)													67	33	33
Automatic Casting/Molding													4	18	-
Numerically Controlled CN Machines (NC)							100	-	-				65	25	8
Computer Controlled Machines (CNC)							100	-	-				41	41	16
CAD Directed CNC							10	34	-				6	33	30
Computerized Process Control Systems	5	21	-	46	22	-	35	54	13	50	50	-	33	39	7
Computer-Aided Inspection and Testing	38	42	-	64	48	-	75	35	-	31	56	-	32	51	14
Robotic Applications	5	21	42	15	53	25	10	31	28	38	57	12	14	39	26
Flexible Manufacturing Technologies	2	-	21	19	19	13	10	43	18	0	59	8	3	24	12
Computer Integrated Manufacturing (CIM)	17	21	-	6	25	43	18	41	7	0	11	11	8	24	14
Carbon Fibre Composites							34	18	-				34	18	-
Fly by Wire Avionics							0	-	21				0	-	21
Other				7	13	-									
4. MATERIALS HANDLING TECHNOLOGIES															
Automatic Bulk Handlers/Feeder Systems	2	-	-				10	-	-	56	22	-	35	17	9
Automated Conveyor/Vehicle Systems	2	-	-	11	33	-	21	-	-	51	41	-	25	21	10
Automated Storage and Retrieval	5	-	-	7	22	22	0	7	-	0	19	10	1	13	17
Computer Controlled Conveyor/Vehicles	2	2	-	7	29	-				0	10	29	1	7	10
Automated Warehouse	2	-	2	0	-	22	0	7	-	0	10	19	4	9	14
Other				7	-	-				0	10	-	1	4	-
5. TELECOMMUNICATIONS TECHNOLOGIES															
Facsimile (FAX) Link: HO/Plant(s)	26	21	-	80	-	-	46	34	0	42	29	7	48	21	7
Computer Link: HO/Plant(s)	26	42	-	77	-	-	44	34	13	38	31	7	44	33	8
Computer Link: Suppliers/Customers	46	-	-	19	33	-	21	21	24	29	42	7	19	50	14
Other				7	-	-							1	4	-
6. OTHER TECHNOLOGIES	2	2	2	0	7	-	7	-	-				9	15	4

(1) '0' used prior to 1985 to indicate have not adopted. '-' used for periods 1985-1990 and 1990-1995 to indicate respondents, at the time of survey are not planning to adopt this technology or 'don't know'. Multiple responses accepted.

TABLE 10: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Rating of Industry Technology Adoption By Selected Technologies

Industry SIC	CAD	CAE	CAD/ CAM	Process Planning	MRP	C-A Process Control	C-A Inspect/ Test	Flexible Manu-facture	NC	CNC	Robotics	CIMS	Materials Handling	Telecom-munications	Overall[1]
291	+	+	-	+	+	+	+	n.a.	+	+	-	o	+	+	+
304	-	-	-	o	-	-	-	-	-	-	-	-	+	+	-
306	o	-	+	+	-	o	-	-	+	+	-	+	-	-	+/-
309	+	+	+	o	+	+	o	-	o	o	+	-	o	+	+/o
315	-	+	+	o	o	-	o	o	o	o	-	o	o	o	o
318	+	+	+	-	-	-	o	+	n.a.	n.a.	-	o	-	-	+
335	+	+	+	+	o	o	o	-	n.a.	n.a.	-	+	+	+	+
321	o	o	o	+	+	+	+	o	+	+	-	+	-	o	+
165	o	o	-	o	+	+	+	-	n.a.	n.a.	+	-	+	o	+/o

+ Leader
o Follower
- Lagger

— Relative to the average adoption or planned adoption rates for the nine industries surveyed.

n.a. - Not generally applicable to the industry.

(1) Other technologies considered as well as those specifically noted above.

EXHIBIT 2

GENERAL CATEGORIZATION OF INDUSTRIES BY RATE OF TECHNOLOGY ADOPTION

Technology Leader	Technology Follower	Technology Lagger
• Iron and Steel (SIC 291)	• Hardware, Tool and Cutlery (SIC 306)	• Metal Stamping, Pressing and Coating (SIC 304)
• Office and Store Machinery (SIC 318)	• Miscellaneous Metal Fabricating (SIC 309)	
• Communications Equipment (SIC 335)	• Miscellaneous Machinery and Equipment (SIC 315)	
• Aircraft (SIC 321)	• Plastic Processing (SIC 165)	

Although the above is useful as a basic framework, the survey results show that there is a high degree of variability within most industries. That is, within a single industry, there are innovators and followers. This variability in adoption rates is particularly evident for the Metal Fabricating, Miscellaneous Machinery and Equipment, Office and Store Machinery and Plastics Processing industries.

Larger firms also tend to be technology leaders due to such factors as: higher skill levels, more sophisticated markets and larger production runs.

Certain technologies have been introduced widely already (e.g., computerized financial systems and inventory control) and some technologies see wide adoption in the near term (before 1990), while others are unlikely to be widely adopted until after 1990. Using the survey results for the nine industries in Table 9, Exhibit 3 categorizes the new technologies as an 'already here', 'near term', or 'mid term' technology.

EXHIBIT 3

GENERAL CATEGORIZATION OF TECHNOLOGIES BY TIME PERIOD

'Already Here' Technologies (Widely Adopted Already)	'Near Term' Technologies (Widely Planned for 1985 to 1990)	'Mid Term' Technologies (Widely Planned for 1990 to 1995)
• Computer Aided Design (CAD) →		
• Computer-Aided Engineering (CAE)		
	CAD/CAM Integration →	
• Products with Installed Microprocessors (SIC 318, 335) →		
• Multifunctional Machines (SIC 318,335) →		
• Computerized Financial Systems		
• Computerized Inventory Control		
• Computerized Order Entry →		
	• Manufacturing Resource Planning (MRP)	
	• Automatic Shop Floor Data Collection	
	• Computerized - Maintenance Planning and Control - Process Control - Testing and Inspecting	
• Numerically Controlled Machines (NC)		
• Computerized NC (CNC) →		
	• CAD Directed CNC →	
	• Flexible Manufacturing →	
		• Computer Integrated Manufacturing (CIM)
• Automated Conveyors/ Vehicles	• Computerized Conveyors/ Vehicles	
	• Automated Warehouse →	
	• Automated Storage and Retrieval →	
• FAX Link With HO/Plant		
• Computer Link with HO/Plant →		
	• Computer Link With Customers/Suppliers	

Some technologies are exclusive to only one or two industries. Other technologies are being implemented now or in the near term by leaders in individual industries. Some of these key technologies for each industry are noted below in Exhibit 4.

EXHIBIT 4

KEY TECHNOLOGY FOCUS OF INDUSTRY LEADERS

Industry	Technology Drive of Leaders Now or in the Near Term
Iron and Steel	Continuous Casting ("near net" forming) Ladle Metallurgy
Metal Fabricating	Flexible Manufacturing CAD/CAM Integration
Miscellaneous Machinery and Equipment	Flexible Manufacturing CAD/CAM Integration
Office and Store Machinery	Advanced Manufacturing Technologies Products With Built-in Microprocessors Multifunctional Machines
Communications Equipment	Advanced Manufacturing Technologies Products With Built-in Microprocessors
Aircraft and Parts	CNC, CAD/CAM, & Flexible Manufacturing Carbon Fiber Composites/Exotic Alloys Computer Link With Suppliers/Customers
Plastic Processing	Computerized In-Process Control Flexible Manufacturing/Robotics

TABLE 11: SELECTED MANUFACTURING INDUSTRIES

Most Important Factors Driving Need to Adopt New Technologies
(Percent of Firms)

Factor		SIC 291	SIC 304	SIC 306	SIC 309	SIC 315	SIC 318	SIC 335	SIC 321	SIC 165	Average of Reporting Firms
COMPETITIVE PRESSURES	First	33	21	39	30	8	65	46	43	49	35
	Second	33	10	16	6	49	0	20	10	0	15
	Third	0	15	0	24	8	0	0	0	0	6
	Weighted Importance (1)	1.7	1.0	1.5	1.3	1.3	1.9	1.8	1.5	1.5	1.4
STRATEGIC	First	0	5	4	0	9	12	0	17	18	9
	Second	0	0	0	17	8	0	0	13	6	5
	Third	33	0	31	0	0	0	0	0	0	7
	Weighted Importance	0.3	0.2	0.4	0.3	0.5	0.4	0.0	0.6	0.7	0.4
CUSTOMER DEMANDS FOR CHANGES	First	0	14	35	12	37	21	8	18	6	17
	Second	0	5	4	17	8	62	12	24	6	13
	Third	0	0	0	0	0	0	0	18	6	3
	Weighted Importance	0.0	0.5	1.1	0.7	1.3	1.9	0.5	1.2	0.3	0.8
INCREASE PROFITABILITY	First	0	0	0	17	1	0	0	7	6	4
	Second	0	0	8	0	0	2	5	0	0	2
	Third	0	14	16	0	8	0	12	0	6	6
	Weighted Importance	0.0	0.1	0.3	0.5	0.1	0.1	0.2	0.2	0.2	0.2
INCREASE PRODUCTIVITY	First	33	14	0	17	17	2	0	0	6	10
	Second	0	14	19	0	9	2	29	0	13	10
	Third	0	10	0	6	1	0	0	10	17	6
	Weighted Importance	1.0	0.8	0.4	0.6	0.7	0.1	0.6	0.1	0.6	0.6
INCREASE MANAGEMENT INFORMATION	First	33	0	0	0	0	0	0	0	0	3
	Second	0	0	16	0	0	0	0	0	11	4
	Third	0	5	0	0	17	0	12	0	0	3
	Weighted Importance	1.0	0.1	0.3	0.0	0.2	0.0	0.1	0.0	0.2	0.2
LOWER COSTS	First	0	20	23	24	28	0	24	0	0	14
	Second	33	20	16	41	25	0	0	10	6	17
	Third	33	20	4	17	0	0	0	0	0	8
	Weighted Importance	1.0	1.2	1.0	1.7	1.4	0.0	0.7	0.2	0.1	0.8
INCREASE SKILLS/ ORGANIZATIONAL CAPABILITY	First	0	15	0	0	0	0	0	0	6	3
	Second	0	0	0	12	0	0	12	7	24	6
	Third	33	5	23	23	28	0	12	7	0	14
	Weighted Importance	0.3	0.5	0.2	0.5	0.3	0.0	0.4	0.2	0.6	0.4
ENTER NEW MARKETS/ GROWTH	First	0	0	0	0	0	0	7	0	6	2
	Second	0	0	0	0	0	0	0	15	0	1
	Third	0	0	4	0	9	0	12	10	49	11
	Weighted Importance	0.0	0.0	0.0	0.0	0.1	0.0	0.6	0.4	0.7	0.2
OBSOLESCENCE	First	0	0	0	0	0	0	0	0	0	0
	Second	0	0	0	0	0	0	5	21	0	2
	Third	0	5	0	0	0	2	0	10	0	2
	Weighted Importance	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.5	0.0	0.1
INCREASE QUALITY	First	0	11	0	0	0	0	0	13	6	3
	Second	33	30	23	6	0	21	12	0	24	4
	Third	0	0	0	7	0	23	22	0	24	3
	Weighted Importance	0.7	0.9	0.5	0.2	0.0	0.7	0.5	0.4	0.9	0.5
ALL OTHERS	First	0	0	0	0	0	0	5	0	0	0
	Second	0	14	0	0	0	12	0	0	13	5
	Third	0	0	4	0	0	0	0	10	0	2
	Weighted Importance	0.0	0.3	0.0	0.0	0.0	0.2	0.2	0.1	0.3	0.2

3.2 Forces Driving the Need to Adopt New Technology

Firms in the industries studied were asked in a series of open-ended questions to identify the three most important factors driving their need to adopt new technology. Table 11 summarizes the results of the survey. It shows the percentage of firms that named a factor as their most important, second most important and third most important. Table 11 also shows the weighted importance of each factor which is derived by the following formula:

Weighted Importance = (Most Important % x 3) + (Second % x 2) + (Third % x 1)

Thus, the most important factors named were given a weighting of three (3); the second most important factors named were given a weighting of two (2); and the third factor named was weighted by one (1). The weighted responses for a factor were then totalled to calculate the weighted importance factor.

A relatively narrow range of forces are driving firms to adopt new technologies. Overall, the reporting firms in the manufacturing industries studied indicate that the critical driving factors are:

	Overall Weighted Importance
• Competitive pressures	1.4
• Customer demands for changes	0.8
• Lower costs	0.8
• Increase productivity	0.6
• Increase quality	0.5
• Increase organization's skills	0.4
• Strategic reasons	0.4

The driving factors did vary, by industry, in terms of the motivational focus for technology adoption as indicated by the following overview in Exhibit 5 which summarizes the survey data presented in Table 11.

EXHIBIT 5

RATING OF DRIVING FACTORS BY IMPORTANCE

Industry	First	Second	Third
Iron and Steel	Competition	Productivity	Management Information
Metal Stamping, Pressing and Coating	Cost	Competition	Quality
Hardware, Tool and Cutlery	Competition	Customer	Cost
Miscellaneous Metal Fabricating	Cost	Competition	Customer
Miscellaneous Machinery and Equipment	Cost	Customer	Competition
Office and Store Machinery	Competition	Customer	Quality
Communications Equipment	Competition	Cost	Customer
Aircraft and Aircraft Parts	Strategic	Customer	Competition
Plastics Fabricating	Competition	Quality	Strategic

In conclusion, competitive pressure is the most important factor driving the need for technology adoption. Obsolescence of existing machinery and equipment, a more traditional concern, was cited by few respondents as a contributing factor.

3.3 Factors That Could Slow the Rate of Technology Adoption

Firms were also asked to name the three most important factors which could slow the rate of technology adoption. Table 12 summarizes the percentage of firms in each industry that identified each factor as most important, second or third. Again, the weighted importance of each factor is shown.

Similarly, a limited number of factors were identified which could slow the rate of technology adoption. Overall, for the reporting firms in the manufacturing industries surveyed, the critical factors that could slow their rate of technology adoption are:

	Overall Weighted Importance
• Poor economic conditions	1.1
• Ability to finance/profitability	1.0
• Cost of new technology	0.9
• Competitive environment	0.9
• Lack of skills to implement	0.8

Again the critical factors cited which could potentially slow the, rate of technology adoption varied by industry. Exhibit 6, below highlights these.

TABLE 12: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Most Important Factors That Could Slow the Rate of New Technology Adoption
(Percent of Firms)

Factor		SIC 291	SIC 304	SIC 306	SIC 309	SIC 315	SIC 318	SIC 335	SIC 321	SIC 165	Average of Reporting Firms
ABILITY TO FINANCE	First	33	18	19	23	20	2	17	21	11	18
	Second	33	6	0	24	8	42	29	10	24	17
	Third	0	17	8	7	21	21	0	24	0	10
	Weighted Importance (1)	1.7	0.9	0.7	1.2	1.0	1.1	1.1	1.1	0.8	1.0
COST OF NEW TECHNOLOGY	First	0	19	16	0	18	0	0	34	31	14
	Second	0	63	23	23	8	0	24	0	11	19
	Third	67	0	0	17	8	0	0	0	0	9
	Weighted Importance	0.7	1.8	0.9	0.6	0.8	0.0	0.5	1.0	1.1	0.9
LACK OF GOVERNMENT ASSISTANCE	First	0	0	0	0	0	0	0	0	0	0
	Second	0	0	0	0	0	0	0	24	0	2
	Third	0	0	16	0	0	0	5	0	0	3
	Weighted Importance	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.5	0.0	0.1
COMPETITIVE ENVIRONMENT	First	33	23	27	35	20	0	5	0	0	16
	Second	0	0	16	6	17	0	12	0	6	7
	Third	0	12	0	0	0	21	0	0	0	3
	Weighted Importance	1.0	0.8	1.1	1.2	0.9	0.2	0.4	0.0	0.1	0.9
POOR ECONOMIC CONDITIONS	First	0	6	23	35	26	12	41	38	17	20
	Second	0	6	35	17	20	42	8	41	31	23
	Third	0	12	0	0	8	0	12	0	6	4
	Weighted Importance	0.0	0.4	1.4	1.4	1.3	1.2	1.5	2.0	1.2	1.1
UNION RESISTANCE	First	0	0	0	0	0	0	0	0	0	0
	Second	0	0	4	0	0	0	5	10	0	2
	Third	0	0	0	0	0	0	0	0	0	0
	Weighted Importance	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.2	0.0	0.0
EMPLOYEE ACCEPTANCE	First	0	0	0	0	0	0	0	0	0	0
	Second	0	0	0	0	0	0	0	0	13	2
	Third	0	0	0	0	0	0	0	0	0	0
	Weighted Importance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
LACK OF SKILLS AND/OR KNOW-HOW TO IMPLEMENT	First	33	0	16	7	8	21	12	0	6	12
	Second	67	19	0	13	18	0	5	7	0	12
	Third	0	17	4	23	0	0	17	21	31	14
	Weighted Importance	2.3	0.5	0.5	0.7	0.6	0.6	0.6	0.4	0.5	0.8
LACK OF NEW TECHNOLOGY STANDARDIZATION	First	0	17	0	0	8	0	0	0	18	6
	Second	0	0	16	0	20	2	0	0	6	5
	Third	0	0	0	0	17	0	0	15	11	5
	Weighted Importance	0.0	0.5	0.3	0.0	0.8	0.1	0.0	0.2	0.8	0.3
UNWILLINGNESS TO CHANGE	First	0	17	0	0	0	0	0	7	13	4
	Second	0	0	0	0	1	0	0	7	0	1
	Third	0	6	0	0	0	0	0	0	0	1
	Weighted Importance	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.2
ALL OTHERS	First	0	0	0	0	0	62	25	0	6	8
	Second	0	0	8	17	0	0	5	0	6	5
	Third	0	0	0	0	0	0	19	0	0	1
	Weighted Importance	0.0	0.0	0.2	0.3	0.0	1.9	1.0	0.0	0.3	0.3

(1) Weighted Importance = (First % x 3) + (Second % x 2) + (Third % x 1)

EXHIBIT 6

RATING OF SLOWING FACTORS BY IMPORTANCE

Industry	First	Second	Third
Iron and Steel	Skills	Finance	Competition
Metal Stamping, Pressing and Coating	Cost	Finance	Competition
Hardware, Tool and Cutlery	Economy	Competition	Cost
Miscellaneous Metal Fabricating	Economy	Competition	Finance
Miscellaneous Machinery and Equipment	Economy	Finance	Competition
Office and Store Machinery	Economy	Finance	Skills
Communications Equipment	Economy	Finance	Skills
Aircraft and Aircraft Parts	Economy	Finance	Cost
Plastic Processing	Economy	Cost	Finance and Technology Standards

The survey clearly demonstrates that manufacturing industries do not perceive employee acceptance or union resistance to new technology as critical factors that will slow their rate of technology adoption. Overall economic performance is the most often cited negative determinant.

3.4 Conclusion

Many firms in the selected industries either have already or plan to adopt many of the new technologies in the near term (i.e., before 1990). The most important factors driving firms to adopt these new technologies are competitive pressures, demands of customers and the need to lower costs, increase productivity and improve product quality. The most significant factors that could slow the rate of technology adoption are poor economic conditions, the firm's profitability and the cost of technology.

4.0 INDUSTRY OUTLOOK TO 1995

This chapter presents the survey results and the views of the experts on the anticipated outlook for the selected manufacturing industries in terms of aggregate output, as measured by the value of manufacturing shipments in Ontario, investment plans, aggregate employment and changes in occupational structure to 1995.

4.1 Output to 1995

Firms were asked to estimate industry-wide growth, using the value of manufacturing shipments. The survey results, by industry, are shown in Table 13. Also provided, as bench marks for comparison, are actual compound growth rates for each industry from 1971 to 1981 and the 1982 value of manufacturing shipments in current dollars.

The estimates for 1982 to 1985 suggest recovery for most industries from the recession. Based on the data in Table 13, Exhibit 7 categorizes each industry's performances from 1982 to 1985 as 'weak' (-), 'modest' (o) or 'strong' (+) recovery relative to the 1981 to 1983 recession. Exhibit 7 also categorizes the 1985 to 1995 outlook for each as weak, moderate or strong, relative to each industry's respective performance over the decade 1971 to 1981.

TABLE 13: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Manufacturing Shipments in Ontario

Average Annual Compound Rate of Change (in Constant Dollars) (1)

SIC	Industry	Estimated 1982-1983	Estimated 1983-1984	Estimated 1984-1985	Expected 1985-1990	Expected 1990-1995	Actual 1971-1981	Actual 1982 Current $ ($ Millions)
291	Iron and Steel	7.0	13.5	3.5	2.5	2.0	3.3	4,692
304	Metal Coating and Stamping Industry	2.5	19.5	7.5	5.5	6.0	2.2	1,787
306	Hardware, Tool and Cutlery Manufacturing	0.0	9.0	6.5	5.0	3.0	3.2	736
309	Miscellaneous Metal Fabricating Industries	-4.5	5.0	5.5	2.0	2.0	1.7	1,042
315	Miscellaneous Machinery and Equipment Manufacturers	-14.5	19.0	6.5	4.5	4.5	3.9	3,092
318	Office and Store Machinery Manufacturers	8.5	7.5	9.0	17.0	17.5	5.6	823
335	Communications Equipment Manufacturers	5.0	10.5	6.0	12.5	10.5	8.3	1,819
321	Aircraft and Aircraft Parts Manufacturers	-4.5	10.5	9.0	7.5	7.0	3.7	836
165	Plastic Processing	3.0	6.5	4.5	6.5	5.5	7.8	1,533

(1) Rounded to nearest 0.5%.

EXHIBIT 7

COMPARATIVE RATING OF INDUSTRY-WIDE

OUTPUT PERFORMANCE AND OUTLOOK

Industry	Recovery From Recession 1982 to 1985	1985 to 1995 Outlook Relative to 1971 to 1981 Performance
Iron and Steel	-	-
Metal Stamping, Pressing and Coating	+	+
Hardware, Tool and Cutlery	+	+
Miscellaneous Metal Fabricating	--	o
Miscellaneous Machinery and Equipment	--	+
Office and Store Machinery	+	++
Communications Equipment	+	+
Aircraft and Aircraft Parts	--	+
Plastic Processing	+	o

+ Strong Recovery	+ Strong Outlook
o Modest Recovery	o Modest Outlook
- Weak Recovery	- Weak Outlook

4.2 Investment Patterns

Firms were asked about their future capital investment plans over the period 1985 to 1990 and 1990 to 1995. The survey results are shown in Table 14.

TABLE 14: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Firms' Capital Investment Plans in Ontario

SIC	Industry		Estimated Investment in Structures and Buildings		Estimated Investment in Machinery and Equipment	
			As a Percent of Total Capital Investment	Percent Related to New Technology	As a Percent of Total Capital Investment	Percent Related to New Technology
291	Iron and Steel	1985 to 1990	22	48	78	54
		1991 to 1995	17	20	83	47
304	Metal Coating and Stamping Industry	1985 to 1990	24	11	76	44
		1991 to 1995	29	12	71	42
306	Hardware, Tool and Cutlery Manufacturing	1985 to 1990	50	1	50	67
		1991 to 1995	56	1	44	65
309	Miscellaneous Metal Fabricating Industries	1985 to 1990	19	22	81	54
		1991 to 1995	22	23	78	47
315	Miscellaneous Machinery and Equipment Manufacturers	1985 to 1990	0	1	100	42
		1991 to 1995	0	2	100	44
318	Office and Store Machinery Manufacturers	1985 to 1990	0	0	100	74
		1991 to 1995	0	0	100	75
335	Communications Equipment Manufacturers	1985 to 1990	17	33	83	50
		1991 to 1995	17	34	83	55
321	Aircraft and Aircraft Parts Manufacturers	1985 to 1990	20	31	80	59
		1991 to 1995	6	19	94	63
165	Plastic Processing	1985 to 1990	30	2	70	51
		1991 to 1995	10	10	90	56
	Average of Reporting Firms	1985 to 1990	21	15	79	54
		1991 to 1995	15	12	85	53

In general, firm responses were incomplete for the mid-term period, that is, they have no plans or are uncertain with respect to capital plans in the period 1990 to 1995.

The survey results show a number of trends. Investment in machinery and equipment is increasing its share of total capital spending for most industries, over time. An increasing share of the expected machinery and equipment expenditures is related to new technology, over time.

On average, about one-half of all expenditures on machinery and equipment from 1985 to 1990 are expected to be related to new technology.

The Hardware, Tool and Cutlery (67%), Office and Store Machinery (74%), and Aircraft (59%) industries show the highest percentages of their machinery and equipment investment plans related to new technology. Metal Coating and Stamping (44%) and Miscellaneous Machinery and Equipment (42%) show the lowest proportion on new technology.

Only a few industries plan a significant share of their capital program on structures and buildings from 1985 to 1990

Iron and Steel	(22%)
Hardware, Tool and Cutlery	(50%)
Miscellaneous Metal Fabricating	(19%)
Aircraft	(20%)
Plastics	(30%)

4.2.1 Justifying Financial Investments in New Technology

Firms in each industry were asked how they evaluate and justify financially investments in new technology. The results of their responses are shown in Table 15.

TABLE 15: SUMMARY - SELECTED MANUFACTURING INDUSTRIES (1)

Justifying Financial Investment in New Technology

SIC	Industry	Pay-Back Period		Return on Investment	
		% of Firms Using Pay-Back	Average Period (2)	% of Firms Using ROI	Average Rate
			(Years)		(Percent)
291	Iron and Steel	67	3.0	100	9
304	Metal Coating and Stamping Industry	100	3.5	47	28
306	Hardware, Tool and Cutlery Manufacturing	68	4.0	72	32
309	Miscellaneous Metal Fabricating Industries	82	5.0	18	30
315	Miscellaneous Machinery and Equipment Manufacturers	92	3.5	9	17
318	Office and Store Machinery Manufacturers	73	2.5	30	13
335	Communications Equipment Manufacturers	75	4.0	83	22
321	Aircraft and Aircraft Parts Manufacturers	52	3.5	60	21
165	Plastic/Processing	75	3.0	37	26
	Average of Reporting Firms	78	3.5	49	22

(1) Multiple responses accepted.
(2) Closest half a year.

The most commonly used measure is the expected pay-back period of the investment, which was used by approximately 78% of the firms. The pay-back period ranged from two to five years. Miscellaneous Metal Fabricating had the longest pay-back period - five years; Office and Store Machinery the shortest - two years. The average pay-back period for the reporting firms was three and a half years.

Return on investment (ROI) is used by almost half of the firms surveyed for evaluating investment decisions. The average expectation is a 22% ROI which is comparable to an average three and a half year pay-back period as discussed above. Office and Store Machinery (13%) and Iron and Steel (9%) had the lowest ROI's and Hardware, Tool and Cutlery (32%) and Miscellaneous Metal Fabricating (30%) the highest.

Many firms use more than one test for evaluating capital investment decisions. Iron and Steel is a good illustration. For major capital decisions, strategic considerations are important and return on investment is most commonly used. For lesser capital decisions, the pay-back concept is utilized. For these decisions, the firms indicate a three year pay-back period while for major capital items, more modest ROI rates (9%) suggest a different standard of evaluation. That is, a 9% ROI is roughly equivalent to a seven year pay-back period. This variable approach to evaluating different types of investments will explain the apparent contradictions of a short pay-back period (two years) for Office and Store Machinery vis-a-vis a relatively modest ROI (13%).

4.2.2 Source of New Capital Spending

Firms in each industry were asked how they will finance their capital programs - from either internal or external

TABLE 16: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

SIC	Industry	Source of Funds for New Technology Spending	
		Internal Funds	External Funds
		Percent	Percent
291	Iron and Steel	77	23
304	Metal Coating and Stamping Industry	73	27
306	Hardware, Tool and Cutlery Manufacturing	70	30
309	Miscellaneous Metal Fabricating Industries	49	51
315	Miscellaneous Machinery and Equipment Manufacturers	87	13
318	Office and Store Machinery Manufacturers	65	35
335	Communications Equipment Manufacturers	84	16
321	Aircraft and Aircraft Parts Manufacturers	62	38
165	Plastic Processing	60	40
	Average of Reporting Firms	71	29

sources. The results, by industry, are presented in Table 16.

Firms in the following industries will rely primarily on internal funding.

Iron and Steel	77%
Metal Coating and Stamping	73%
Hardware, Tool and Cutlery	70%
Miscellaneous Machinery and Equipment	87%
Communications Equipment	84%

The following industries will rely on approximately half of their funds from external sources.

Miscellaneous Metal Fabricating	51%
Plastic Processing	40%

4.3 Employment to 1995

This section of the report reviews expected trends in employment patterns and the most important factors which will influence employment of firms.

4.3.1 Factors Affecting Employment

Firms in each industry were asked, in a series of open-ended questions, to identify the most important factors which would affect their firms' future employment levels in Ontario. The detailed results are shown in Table 17. The same weighted importance procedure, as described above, was used to help analyze the survey results.

Overall, for the reporting firms, the most important factors are:

TABLE 17: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Most Important Factors Affecting the Firms' Employment in Ontario
(Percent of Firms)

Factor		SIC 291	SIC 304	SIC 306	SIC 309	SIC 315	SIC 318	SIC 335	SIC 321	SIC 165	Average of Reporting Firms
PROFITABILITY/ FINANCIAL STRENGTH	First	0	6	4	0	0	21	0	0	19	10
	Second	0	12	4	0	7	0	0	0	0	3
	Third	0	0	18	0	14	0	0	15	12	7
	Weighted Importance (1)	0.0	0.4	0.4	0.0	0.3	0.6	0.0	0.2	0.7	0.4
INCREASE SALES/ INCREASE MARKET SHARE	First	0	0	27	23	7	33	25	23	18	14
	Second	0	40	0	17	0	21	12	12	0	11
	Third	0	0	0	6	1	2	0	0	0	1
	Weighted Importance	0.0	0.8	0.8	1.1	0.2	1.4	1.0	0.9	0.5	0.7
INTRODUCTION OF NEW TECHNOLOGY	First	0	23	4	0	0	0	12	0	0	5
	Second	33	0	4	17	7	0	22	34	37	18
	Third	0	18	4	0	7	12	24	0	0	6
	Weighted Importance	0.7	0.9	0.3	0.3	0.2	0.1	1.0	0.7	0.7	0.6
SUCCESS IN FOREIGN MARKETS	First	0	0	0	0	17	2	5	34	0	6
	Second	0	0	0	0	7	0	0	0	6	2
	Third	0	6	4	6	0	0	0	0	13	4
	Weighted Importance	0.0	0.1	0.0	0.1	0.7	0.1	0.2	1.0	0.3	0.3
AVAILABILITY OF NECESSARY SKILLS	First	33	0	18	0	0	0	0	0	0	5
	Second	0	17	23	0	0	21	5	12	0	8
	Third	0	0	4	0	7	0	0	8	0	2
	Weighted Importance	1.0	0.3	1.1	0.0	0.1	0.4	0.1	0.3	0.0	0.2
ABILITY TO COMPETE	First	0	12	18	18	15	2	5	8	38	15
	Second	67	0	9	41	31	2	25	20	0	19
	Third	0	17	0	0	7	0	0	12	0	4
	Weighted Importance	1.3	0.5	0.7	1.3	1.1	0.1	0.7	0.8	1.2	0.9
INDUSTRY-WIDE GROWTH	First	33	23	27	29	24	0	41	20	6	22
	Second	0	6	18	6	0	0	0	0	13	6
	Third	0	0	0	0	7	0	0	12	0	2
	Weighted Importance	1.0	0.8	1.2	1.0	0.8	0.0	1.2	0.7	0.4	0.7
OVERALL ECONOMIC GROWTH	First	0	12	0	23	24	21	12	15	0	12
	Second	0	12	0	6	31	0	12	0	0	7
	Third	0	0	0	0	0	0	0	0	6	1
	Weighted Importance	0.0	0.6	0.0	0.8	1.3	0.6	0.6	0.4	0.1	0.6
FOREIGN EXCHANGE RATE/CANADIAN COMPETITIVENESS	First	33	6	0	6	7	0	0	0	6	6
	Second	0	6	0	0	0	0	0	0	13	3
	Third	0	0	4	0	17	0	0	12	0	4
	Weighted Importance	1.0	0.3	0.0	0.2	0.4	0.0	0.0	0.1	0.4	0.3
PRODUCT DIVERSIFICATION	First	0	0	0	0	7	0	0	0	13	3
	Second	0	6	4	13	0	0	12	0	31	9
	Third	0	6	0	17	7	21	5	0	12	8
	Weighted Importance	0.0	0.2	0.1	0.4	0.3	0.2	0.3	0.0	1.1	0.4
ALL OTHERS	First	0	17	0	0	0	21	0	0	0	2
	Second	0	0	0	0	1	33	0	15	0	1
	Third	100	0	9	0	0	21	0	12	0	13
	Weighted Importance	1.0	0.5	0.1	0.0	0.0	1.4	0.0	0.4	0.0	0.2

(1) Weighted Importance = (First % x 3) + (Second % x 2) + (Third % x 1)

	Overall Weighted Importance
Ability to compete	0.9
Industry-wide growth	0.7
Increases sales/market share	0.7
Overall economic growth	0.6
New technology	0.6

Variations in factors by industry are summarized below in Exhibit 8.

EXHIBIT 8

RATING OF FACTORS AFFECTING EMPLOYMENT BY IMPORTANCE

Industry	Most Important	Second	Third
Iron and Steel	Compete	Skills Industry growth Dollar	Technology
Metal Stamping, Pressing and Coating	Technology	Market share	Industry growth
Hardware, Tool and Cutlery	Industry growth	Skills	Market share
Miscellaneous Metal Fabricating	Compete	Market share	Industry growth
Miscellaneous Machinery and Equipment	Economic growth	Compete	Industry growth
Office and Store Machinery	Market share	Economic growth	Profit-ability
Communications Equipment	Industry growth	Market share	Technology
Aircraft and Aircraft Parts	Exports	Market share	Compete
Plastic Processing	Compete	Product diversifi-cation	Technology profit-ability

TABLE 18: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Firms' Employment Trends in Ontario

SIC	Industry	Average Annual Compound Rate of Change (1)					
		Estimated		Expected		Actual	
		Rate		Rate		Rate	
		1981-1984	1984-1985	1985-1990	1990-1995	1971-1981	1982 Employment Level (2)
291	Iron and Steel	-7.0	2.5	1.0	0.5	1.2	41,600
304	Metal Coating and Stamping Industry	3.5	0.5	1.0	1.0	0.3	17,700
306	Hardware, Tool and Cutlery Manufacturing	-0.5	5.5	2.5	1.5	2.7	12,800
309	Miscellaneous Metal Fabricating Industries	-3.5	4.5	0.5	0.0	0.8	12,200
315	Miscellaneous Machinery and Equipment Manufacturers	-1.0	0.0	2.5	2.0	2.2	36,900
318	Office and Store Machinery Manufacturers	2.5	5.0	4.0	3.5	4.0	10,500
335	Communications Equipment Manufacturers	4.0	-6.5	3.0	4.5	2.0	28,100
321	Aircraft and Aircraft Parts Manufacturers	-7.5	9.5	-0.5	1.0	3.6	12,700
165	Plastic Processing	9.0	7.5	3.0	1.0	4.2	19,200

(1) Rounded to nearest 0.5%.
(2) Rounded to nearest 100.

Industry-wide growth, economic growth and ability to gain increased sales and market share are dominant themes. Ability to compete is the single strongest factor, with technology a distant third or fourth factor.

As seen earlier, firms see the need for new technology to remain competitive. If they are not competitive, there will not be jobs. The survey results are unclear as to what is the competition. In general, the survey results suggest domestic competition, given the high response rates to 'industry-wide' and 'overall economic' growth, and the low response rate to export or foreign market success as a significant employment determinant.

4.3.2 Aggregate Firm Employment Outlook

Firms in each industry were asked to indicate their firms' estimate of employment in Ontario since 1982 and to indicate their expectations for firm employment growth in Ontario to 1995. The results are shown in Table 18. Below, in Exhibit 9, the post-recessionary job creation performance of each industry is rated in terms of strong (+), modest (o) or weak (-) recovery from employment losses during the 1981 to 1983 recession. Also rated as strong, modest or weak is the industry-wide employment outlook from 1985 to 1995 relative to its job creation performance during the 1971 to 1981 period.

Also provided, as bench marks for comparison, are the actual compound rates of growth for the decade 1971 to 1981 and 1982 actual employment levels for each industry.

EXHIBIT 9

COMPARATIVE RATING OF INDUSTRY-WIDE EMPLOYMENT PERFORMANCE AND OUTLOOK

Industry	Recovery From Recession 1982 to 1985	1985 to 1995 Outlook Relative to 1971 to 1981
Iron and Steel	-	-
Metal Stamping, Pressing and Coating	+	o
Hardware, Tool and Cutlery	-	o
Miscellaneous Metal Fabricating	-	o
Miscellaneous Machinery and Equipment	-	-
Office and Store Machinery	+	o
Communications Equipment	o	+
Aircraft and Aircraft Parts	-	-
Plastic Processing	+	-

+ Strong Recovery + Strong Outlook

o Modest Recovery o Modest Outlook

- Weak Recovery - Weak Outlook

Overall, the following observations can be made.

- Several industries appear to have been cautious in the post-recessionary period in terms of employment call-backs or hiring relative to the apparent recovery of output levels in recent years, or have become considerably more productive with their existing work forces.

- The employment outlook for the near term (1985 to 1990) is more buoyant than for the mid-term (1990 to 1995).

- The employment outlook for the next ten years, for many industries, is relatively close to the actual employment growth experienced from 1971 to 1981.

4.3.3 Trends in Part-Time Work

Increased usage of part-time employment is a trend in many service industries; however, results of the survey suggest modest changes in the use of part-time workers in the future for the selected manufacturing industries. Table 19 shows the survey results.

During the 1981 to 1985 period, firms in four industries showed an increased use of part-time employees: Miscellaneous Machinery, Office and Store Machinery, Aircraft and Plastics Fabricating. Two showed a decrease: Metal Coating and Stamping, and Communications Equipment. Firms in Metal Coating and Stamping, Aircraft and Plastics are the only industries in 1985 with over 3% of its employees working part-time.

TABLE 19: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

SIC	Industry	Part-Time Employees as a Percent of Firms' Total Employment in Ontario (1)				
		Estimated			Expected	
		1981	1984	1985	1990	1995
291	Iron and Steel	0.0	0.0	0.0	1.0	2.0
304	Metal Coating and Stamping Industry	4.0	3.0	3.0	3.0	2.5
306	Hardware, Tool and Cutlery Manufacturing	0.0	0.5	0.0	0.0	0.0
309	Miscellaneous Metal Fabricating Industries	0.0	0.0	0.0	0.0	0.0
315	Miscellaneous Machinery and Equipment Manufacturers	1.0	1.0	2.0	2.0	2.0
318	Office and Store Machinery Manufacturers	0.5	2.0	2.0	1.5	1.5
335	Communications Equipment Manufacturers	1.0	0.5	0.5	2.0	2.5
321	Aircraft and Aircraft Parts Manufacturers	3.0	3.0	3.5	4.0	4.0
165	Plastic Processing	1.0	1.5	4.5	5.5	5.5
	Average of Reporting Firms	1.0	1.0	1.5	2.0	2.5

(1) Rounded to closest 0.5%.

For the near and medium term for the firms surveyed, an increase in part-time employment is anticipated, from 1% in 1981 to 1.5% in 1985 to 2% in 1990 and 2.5% by 1995. The following industries show increased or decreased dependency on part-time employment from 1985 to 1995.

Increased Use of Part-Time Employees	Decreased Use of Part-Time Employees
- Iron and Steel	- Office and Store Machinery
- Communications Equipment	
- Aircraft	
- Plastics	

The remaining industries are expecting to be essentially unchanged.

4.3.4 Trends in Full-Time Equivalency (FTE)

Due to modest changes in the use of part-time work, there are no significant trends in employment as measured in full-time equivalency.

4.4 Changes in Occupational Structure

Firms were also asked about expected changes in the occupational structure of their firm's work force over the next ten years. Firms were asked to respond to selected occupations. The results of these questions and the selected occupations are reported in Table 20.

The results of Table 20 are further summarized in Table 21 below which suggests the overall direction for occupations in each major category during the period 1985 to 1995, that is, whether the occupation's proportion of the total work force is expected to increase (+), decrease (-) or remain about the same (o).

TABLE 20: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Trends in Firms' Occupational Structure
(Percent by Occupation) (1)

SIC	Industry	Year	Managerial, Administrative, and Related	Natural Sciences, Engineering and Mathematics	Processing	Machining	Fabricating, Assembling and Repairing	Materials Handling and Related	All Other Occupations	Total
291	Iron and Steel	1981	12.0	4.5	17.5	13.5	10.0	10.5	32.0	100%
		1984	12.5	4.5	20.5	16.0	8.0	12.0	26.5	100%
		1985	12.5	5.0	20.5	16.0	8.0	11.5	26.5	100%
		1990	13.0	6.5	18.5	18.0	8.5	11.5	24.0	100%
		1995	13.5	8.0	18.0	20.0	9.5	12.0	19.0	100%
304	Metal Coating and Stamping Industry	1981	14.5	2.5	29.5	20.5	10.5	8.0	15.0	100%
		1984	12.0	2.0	36.0	16.5	11.5	8.0	14.0	100%
		1985	12.5	2.5	37.5	15.0	11.5	7.5	14.0	100%
		1990	13.0	3.0	36.0	16.5	12.5	6.5	12.5	100%
		1995	13.0	3.0	35.5	16.5	12.5	6.5	13.0	100%
306	Hardware, Tool and Cutlery Manufacturing	1981	20.0	6.0	2.5	45.5	11.0	6.0	9.5	100%
		1984	16.5	5.0	2.5	51.5	10.0	6.0	8.5	100%
		1985	15.5	5.0	2.0	54.5	9.5	5.5	8.0	100%
		1990	14.0	6.0	3.5	53.5	11.0	5.0	7.5	100%
		1995	13.0	5.5	3.0	54.5	11.5	4.5	8.0	100%
309	Miscellaneous Metal Fabricating Industries	1981	19.0	3.5	13.5	18.5	33.0	7.0	5.0	100%
		1984	19.5	3.5	13.0	17.5	33.5	7.5	6.0	100%
		1985	19.0	3.5	12.5	18.5	34.0	7.0	5.5	100%
		1990	18.0	5.0	13.5	19.0	31.5	6.5	6.5	100%
		1995	18.0	5.0	14.0	20.0	30.5	6.0	6.5	100%
315	Miscellaneous Machinery and Equipment Manufacturers	1981	13.0	5.0	7.0	27.0	26.0	4.0	18.0	100%
		1984	14.5	5.5	6.0	27.0	26.5	4.0	16.5	100%
		1985	15.0	6.0	5.5	29.5	26.0	3.5	14.0	100%
		1990	13.0	7.5	4.5	33.0	24.5	3.0	14.0	100%
		1995	13.0	7.5	4.5	34.0	24.0	3.0	14.0	100%
318	Office and Store Machinery Manufacturers	1981	25.5	19.5	0.0	9.0	32.0	2.5	12.0	100%
		1984	24.5	20.5	0.0	6.5	33.0	2.5	13.0	100%
		1985	24.5	20.5	0.0	6.5	32.5	2.5	13.5	100%
		1990	23.0	21.5	0.0	6.5	31.5	2.5	14.5	100%
		1995	22.0	21.5	0.0	6.5	32.5	2.5	14.5	100%
335	Communications Equipment Manufacturers	1981	11.5	13.5	0.5	3.5	55.0	5.0	11.0	100%
		1984	11.5	13.5	0.5	3.5	58.0	5.0	8.5	100%
		1985	11.5	16.0	0.5	3.0	55.5	6.0	8.0	100%
		1990	11.5	17.0	0.5	3.0	54.0	5.5	8.5	100%
		1995	11.5	19.5	0.5	3.5	52.5	5.5	7.5	100%
321	Aircraft and Aircraft Parts Manufacturers	1981	5.5	10.0	13.0	20.0	35.5	6.0	10.0	100%
		1984	7.0	11.0	14.5	21.5	30.5	6.5	9.0	100%
		1985	7.0	10.5	13.5	21.0	30.0	6.5	11.5	100%
		1990	9.5	12.5	12.0	25.0	24.0	6.5	11.0	100%
		1995	9.5	12.0	11.5	25.0	25.0	6.0	10.5	100%
165	Plastic Processing	1981	13.0	6.0	24.5	9.0	31.5	4.5	11.0	100%
		1984	12.5	6.0	19.0	11.0	33.5	5.0	13.0	100%
		1985	12.5	6.5	18.5	11.5	33.5	5.0	12.5	100%
		1990	11.5	9.5	18.0	12.5	30.0	5.5	13.0	100%
		1995	12.5	11.0	18.0	12.0	28.5	5.5	13.0	100%

(1) Rounded to closest 0.5%.

TABLE 21: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Summary of Anticipated Trends in Firms' Occupational Structure
1985 - 1995

SIC	Industry	Managerial, Administrative, and Related	Natural Sciences, Engineering and Mathematics	Processing	Machining	Fabricating, Assembling and Repairing	Materials Handling and Related	All Other Occupations
291	Iron and Steel	+	+	-	+	+	+	-
304	Metal Coating and Stamping Industry	+	+	-	+	+	-	-
306	Hardware, Tool and Cutlery Manufacturing	-	+	+	+	+	-	-
309	Miscellaneous Metal Fabricating Industries	-	+	+	+	-	-	+
315	Miscellaneous Machinery and Equipment Manufacturers	-	+	-	+	-	-	-
318	Office and Store Machinery Manufacturers	-	+	n.a.	o	+	o	+
335	Communications Equipment Manufacturers	o	+	o	+	-	-	-
321	Aircraft and Aircraft Parts Manufacturers	+	+	-	+	-	-	-
165	Plastic Processing	o	+	-	+	-	+	o

\+ increase in occupation's proportion of total employment
o little change in occupation's proportion of total employment
\- decrease in occupation's proportion of total employment
n.a. not applicable

Looking across all industries surveyed for a major occupational group, some patterns are clear:

- an increased proportion of the work force will be employed in the Natural Science, Engineering and Mathematics occupations,

- a decreased proportion will be employed in Material Handling and Related occupations, and

- an increased proportion will be employed in machining occupations.

At these broad occupational categories, there are no other clear occupational shifts across the selected manufacturing industries.

When reviewing these tables, it should be kept in mind, however, that a reduction in the percentage of the total work force does not necessarily translate into a loss of jobs in the occupational category due to growth in the number of total employees over time. Similarly, there may be changes in specific occupations within the broad occupational categories shown in Tables 20 and 21. Discussion on expected changes in specific occupations is contained in each of the industry reports.

5.0 EMPLOYMENT EFFECTS OF NEW TECHNOLOGY

This chapter reviews the survey results on the employment effects of new technology in terms of skills match and requirements, and impact on skill levels and job content.

5.1 Effects on Occupations

Table 22 summarizes firms' expectations of technology impacts on occupational requirements, by industry. Firms in each industry were asked to identify potential skill shortages (-) or oversupply situations (+) in specific occupations due to technology change. The occupations selected for each industry were chosen, based on an analysis of occupational changes in each industry for the period 1971 to 1981. Where there was a significant proportion of the work force in a specific occupation or an unusual shift in the proportion of the total industry work force during the 1971 to 1981 period, the occupation was selected for the survey.

As a further step, to help the reader, Table 23 lists the selected occupations, by industry, in which 35% or more of the firms anticipate an oversupply of skills due to the adoption of new technology. Table 24 does the same for the occupations in which a shortage of skills is anticipated.

Occupations shown in capitals (e.g., PROCESSING) in Tables 23 and 24 are defined as major occupational groups, while occupations in upper and lower case type (e.g., Systems Analyst) in Tables 23 and 24 are minor occupational groups, as defined by the 1971 Canadian Classification and Dictionary of Occupations.

TABLE 22: SUMMARY - SELECTED MANUFACTURING INDUSTRIES (1)

Impact of Technology on Selected Occupations in Firms
Percent of Firms Identifying OVERSUPPLY (+) or SHORTAGE (-) of Skills

Occupations	SIC 291			SIC 304			SIC 306			SIC 309			SIC 315			SIC 318			SIC 321			SIC 335			SIC 165		
	+	-	NR	+	-	NR	+	-	NR	+	-	NR	+	-	NR	+	-	NR	+	-	NR	+	-	NR	+	-	NR
MANAGERIAL, ADMINISTRATIVE AND RELATED	0	67	33	0	45	55	19	31	50	7	41	53	2	25	73	2	23	75	0	61	39	13	56	32	22	35	43
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS																											
• Electrical Engineers																42	5	54				27	27	46			
• All Other Engineers																42	17	42				39	10	51			
• Engineers	0	100	0	0	16	84	16	46	39	0	36	64	21	43	37				15	62	23				6	53	42
• Engineering Technicians and Technologists	0	100	0	0	32	68	19	58	23	0	60	40	9	63	28	21	79	0	15	47	38	39	44	17	6	58	36
• Draughtsmen																			34	31	34						
• Systems Analysts and Computer Programmers	0	100	0	0	30	70	7	89	4	17	13	70	0	57	43	21	46	33	34	39	26	15	63	20	0	40	60
PROCESSING	67	0	33	25	5	70	8	32	60	7	0	93	26	20	54	0	0	100	20	54	26	13	5	82	6	38	56
MACHINING																											
• Foremen																			0	88	12						
• Tool and Die Making (and Mold Makers SIC 165)				5	1	94	16	65	19	1	36	63	0	75	25				0	77	23	5	34	61	0	58	42
• Machinist and Machine Tool Setting-Up	0	67	33	5	40	55	31	39	30	1	24	75	1	82	17				0	100	0	17	22	61	6	60	33
• Machine Tool Operators	33	33	33	25	5	70	39	39	22	24	23	53	8	74	18							29	5	66			
• Metal Shaping and Forming				10	0	90	47	19	34	7	47	46							12	53	35						
• Filing, Grinding, Buffing, Cleaning and Polishing				20	5	75	42	19	39	30	0	70	43	20	37												
• All Other Metal Shaping and Forming													36	0	64												
• Welding/Soldering	0	67	33										38	18	44	21	12	67				18	18	64			
FABRICATING, ASSEMBLING AND REPAIRING																											
• Supervisors (SIC 165)																									11	53	36
• Foremen													10	45	45							24	61	15			
• Fabricating and Assembling Metal Products				20	5	75	8	0	92	47	0	53															
• Machinery: Fabricating and Assembling													11	28	61												
• Business and Commercial Machines Fabricating and Assembling (SIC 318)																23	42	35									
• Aircraft Fabricating and Assembling (SIC 321)																			23	20	57						
• Electrical Equipment Fabricating and Assembling																						27	15	58			
• Electronic Equipment Fabricating and Assembling																23	42	35				58	25	17			
• Plastics Fabricating (SIC 165)																									29	18	53
• Plastics Molding (SIC 165)																									42	24	36
• Electrical Equipment Installing and Repairing	0	67	33										0	47	53				0	46	54						
• Industrial Machinery Mechanics and Repairmen	0	67	33	0	49	51	0	65	35	17	42	41	0	80	20												
• Business and Commercial Machine Mechanics and Repairmen (SIC 318)																23	62	15									
• Aircraft Mechanics (SIC 321)																			12	0	88						
• Inspecting and Testing																2	42	58	11	46	43	55	39	6			
MATERIALS HANDLING AND RELATED	67	0	33	20	5	75	39	15	46	7	0	94	18	0	82	44	0	56	8	0	92	56	5	39	40	0	60
OTHER OCCUPATIONS	0	0	100	0	1	99	0	15	85	0	17	83	0	18	82	0	0	100	0	20	80	5	34	61	6	6	89

+ Oversupply - Shortage NR No Response

(1) Blank spaces indicate the occupation was NOT one of selected occupations for the industry.

TABLE 23: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Impact of Technology on Selected Occupations in Firms
1985-1995
Anticipated OVERSUPPLY

SIC	Industry	35 Percent of More of Firms Identify OVERSUPPLY
291	Iron and Steel	MATERIALS HANDLING AND RELATED PROCESSING
304	Metal Coating and Stamping Industry	
306	Hardware, Tool and Cutlery Manufacturing	Machine Tool Operators, Metal Shaping and Forming, Filing, Grinding, Buffing, Cleaning and Polishing MATERIALS HANDLING AND RELATED
309	Miscellaneous Metal Fabricating Industries	Fabricating and Assembling Metal Products
315	Miscellaneous Machinery and Equipment Manufacturers	Filing, Grinding, Buffing, Cleaning and Polishing All Other Metal Shaping and Forming, Welding and Flame Cutting
318	Office and Store Machinery Manufacturers	Electrical Engineers, All Other Engineers, MATERIALS HANDLING AND RELATED
335	Communications Equipment Manufacturers	All Other Engineers, Engineering Technicians and Technologists, Electronic Equipment Fabricating and Assembling, Testing and Inspecting, MATERIALS HANDLING AND RELATED
321	Aircraft and Aircraft Parts Manufacturers	
165	Plastic Processing	Molding Plastics, MATERIALS HANDLING AND RELATED

TABLE 24: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Impact of Technology on Selected Occupations in Firms
1985-1995
Anticipated SHORTAGE

SIC	Industry	35 Percent of More of Firms Identify SHORTAGE
291	Iron and Steel	MANAGERIAL, ADMINISTRATIVE AND RELATED, Engineers, Engineering Technicians and Technologists, Systems Analysts and Computer Programmers, Machinist and Machine Tool Setting-Up, Welding/Soldering, Electrical Equipment Installing and Repairing, Industrial Machinery Mechanics and Repairmen
304	Metal Coating and Stamping Industry	MANAGERIAL, ADMINISTRATIVE AND RELATED, Machinist and Machine Tool Setting-Up, Industrial Machinery Mechanics and Repairmen
306	Hardware, Tool and Cutlery Manufacturing	Engineers, Engineering Technicians and Technologists, Systems Analysts and Computer Programmers, Tool and Die Making, Machinist and Machine Tool Setting-Up, Machine Tool Operators, Industrial Machinery Mechanics and Repairmen
309	Miscellaneous Metal Fabricating Industries	MANAGERIAL, ADMINISTRATIVE AND RELATED, Engineers, Engineering Technicians and Technologists, Tool and Die Making, Metal Shaping and Forming, Industrial Machinery Mechanics and Repairmen
315	Miscellaneous Machinery and Equipment Manufacturers	Engineers, Engineering Technicians and Technologists, Systems Analysts and Computer Programmers, Tool and Die Making, Machinist and Machine Tool Setting-Up, Machine Tool Operators, Fabricating Foremen, Electrical Equipment Installing and Repairing, Industrial Machinery Mechanics and Repairmen
318	Office and Store Machinery Manufacturers	Engineering Technicians and Technologists, Systems Analysts and Computer Programmers, Business and Commercial Machines Fabricating and Assembling, Electronic Equipment Fabricating and Assembling, Business and Commercial Machine Mechanics and Repairmen,Testing and Inspecting
335	Communications Equipment Manufacturers	MANAGERIAL, ADMINISTRATIVE AND RELATED, Engineering Technicians and Technologists, Systems Analysts and Computer Programmers, Fabricating Foremen, Testing and Inspecting
321	Aircraft and Aircraft Parts Manufacturers	MANAGERIAL, ADMINISTRATIVE AND RELATED, Engineers, Engineering Technicians and Technologists, Systems Analysts and Computer Programmers, PROCESSING, Machining Foremen, Tool and Die Making, Machinist and Machine Tool Setting-Up, Metal Shaping and Forming, Electrical Equipment Installing and Repairing, Testing and Inspecting
165	Plastic Processing	MANAGERIAL, ADMINISTRATIVE AND RELATED, Engineers, Engineering Technicians and Technologists, Systems Analysts and Computer Programmers, PROCESSING, Tool and Die Making, Machinist and Machine Tool Setting-Up, Supervisors (Fabricating)

Tables 23 and 24, show that many more skill shortages are expected than oversupply situations.

For some occupations, firms in one industry expect an oversupply, while in another industry, a shortage is expected for the same occupation.

A few occupations, within the same industry, are expected by some firms to be in oversupply while others expect a shortage. In these cases, there is obviously no consensus on the technology impacts on this occupation even within the same industry.

Exhibit 10, below, presents a further consolidation, by industry, of frequently identified occupations in which 35% or more of the firms anticipated a shortage of skills in their organizations. The most commonly identified were:

- Managerial, Administrative and Related,
- Engineers,
- Engineering Technicians and Technologists,
- Systems Analysts and Computer Programmers,
- Tool and Die Makers,
- Machinist and Machine Tool Set-up, and
- Various Installing and Repairing occupations.

EXHIBIT 10

OCCUPATIONS FREQUENTLY IDENTIFIED AS SHORTAGES IN TABLE 24

SIC	Industry	Managerial & Related	Engineers	Engineer Technicians	Systems Analysts/ Programmers	Tool & Die	Machinist/ Machine Set-Up	Machine Operators	Fabricating & Assembly	Supervisory Foremen	Test & Inspect	Install & Repair Mechanics
291	Iron and Steel	x	x	x	x		x					x
304	Metal Stamping, Pressing and Coating	x					x					x
306	Hardware, Tool and Cutlery		x	x	x	x	x	x				x
309	Miscellaneous Metal Fabricating	x	x	x		x						x
315	Miscellaneous Machinery and Equipment		x	x	x	x	x	x		x		x
318	Office and Store Machinery			x	x				x		x	x
335	Communications Equipment	x		x	x	x				x	x	
321	Aircraft and Aircraft Parts	x	x	x	x	x	x			x	x	x
165	Plastic Processing	x	x	x	x	x	x			x		

5.2 Likely Steps to Deal With Skills Oversupply

In dealing with a potential oversupply of skills in their organizations, the most commonly cited action, across the manufacturing industries surveyed was attrition. A close second was the use of retraining. A distant third was layoffs. All other measures were less frequently mentioned. Table 25 summarizes the most likely steps for each industry.

5.3 Likely Steps to Cope With Skill Shortages

In coping with anticipated skill shortages in their organizations, the most commonly cited steps named by firms in the manufacturing industries surveyed were in descending order:

- recruitment,
- retraining, and
- upgrading.

Table 26 summarizes the survey results for each industry. The industries reflect the above pattern fairly uniformally.

TABLE 25: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Most Likely Steps Firms Will Take to Deal With
OVERSUPPLY of Skills
1985-1995

SIC	Industry	Most Commonly Cited	Second Most Common	Third Most Common
291	Iron and Steel	Attrition	Transfer	Early Retirement
304	Metal Coating and Stamping Industry	Relocate	Layoff	Attrition
306	Hardware, Tool and Cutlery Manufacturing	Retrain	Layoff	Attrition
309	Miscellaneous Metal Fabricating Industries	Attrition	Retrain	Shorter Hours/ Layoff
315	Miscellaneous Machinery and Equipment Manufacturers	Attrition	Retrain	Transfer
318	Office and Store Machinery Manufacturers	Retrain	Attrition	Layoff
335	Communications Equipment Manufacturers	Layoff	Attrition	Retrain
321	Aircraft and Aircraft Parts Manufacturers	Retrain	Layoff	Attrition
165	Plastic Processing	Attrition	Retrain	Layoff

TABLE 26: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Most Likely Steps Firms Will Take to Deal With
SHORTAGE of Skills
1985-1995

SIC	Industry	Most Commonly Cited	Second Most Common	Third Most Common
291	Iron and Steel	Recruit	Retrain	Upgrade
304	Metal Coating and Stamping Industry	Recruit	Retrain	Upgrade
306	Hardware, Tool and Cutlery Manufacturing	Retrain	Recruit	Upgrade/ Overtime
309	Miscellaneous Metal Fabricating Industries	Recruit	Retrain	Overtime/ Contract Out
315	Miscellaneous Machinery and Equipment Manufacturers	Recruit	Upgrade	Retrain
318	Office and Store Machinery Manufacturers	Recruit	Retrain	Contract Out
335	Communications Equipment Manufacturers	Recruit	Retrain	Upgrade
321	Aircraft and Aircraft Parts Manufacturers	Recruit	Retrain	Upgrade
165	Plastic Processing	Recruit	Retrain	Upgrade

TABLE 27: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Impact of Technology on Skill Levels and Job Content

Occupations	Percent of Firms: Skills Required +	Skills Required −	Skills Required 0	Time to Achieve Proficiency +	Time to Achieve Proficiency −	Time to Achieve Proficiency 0	Knowledge of Firm's Operations +	Knowledge of Firm's Operations −	Knowledge of Firm's Operations 0
MANAGERIAL, ADMINISTRATIVE AND RELATED	87	0	13	39	16	45	68	0	32
NATURAL SCIENCES, ENGINEERING AND MATHEMATICS									
• Electrical Engineers	64	0	36	42	22	37	44	9	48
• All Other Engineers	73	0	27	27	27	47	53	0	47
• Engineers	83	3	14	33	23	44	70	1	29
• Engineering Technicians and Technologists	88	3	8	50	20	30	61	1	38
• Draughtsmen	37	13	50	13	50	37	0	13	87
• Systems Analysts and Computer Programmers	75	5	20	34	16	50	69	0	31
PROCESSING	66	6	29	38	18	49	38	1	60
MACHINING									
• Foremen	77	0	23	54	0	46	66	0	34
• Tool and Die Making (and Mold Makers SIC 165)	41	9	50	20	15	65	24	1	75
• Machinist and Machine Tool Setting-Up	69	16	15	34	24	43	28	9	64
• Machine Tool Operators	48	18	35	15	25	60	29	4	68
• Metal Shaping and Forming	34	21	45	6	24	71	25	3	73
• Filing, Grinding, Buffing, Cleaning and Polishing	14	22	63	7	14	79	10	7	83
• All Other Metal Shaping and Forming	0	42	58	0	27	73	3	0	97
• Welding/Soldering	41	19	40	16	24	60	31	0	69

TABLE 27: SUMMARY - SELECTED MANUFACTURING INDUSTRIES, Continued

Impact of Technology on Skill Levels and Job Content

Occupations	Percent of Firms: Skills Required +	Skills Required −	Skills Required 0	Time to Achieve Proficiency +	Time to Achieve Proficiency −	Time to Achieve Proficiency 0	Knowledge of Firm's Operations +	Knowledge of Firm's Operations −	Knowledge of Firm's Operations 0
FABRICATING, ASSEMBLING AND REPAIRING									
• Supervisors (SIC 165)	87	0	13	49	22	29	43	0	57
• Foremen	79	0	21	37	16	47	59	0	42
• Fabricating and Assembling Metal Products	18	9	73	12	7	81	0	5	95
• Machinery: Fabricating and Assembling	39	4	57	24	5	71	3	0	97
• Business and Commercial Machines Fabricating and Assembling (SIC 318)	55	26	19	3	26	71	68	0	32
• Aircraft Fabricating and Assembling (SIC 321)	48	13	40	30	13	58	12	0	88
• Electrical Equipment Fabricating and Assembling	67	0	33	38	40	33	19	0	81
• Electronic Equipment Fabricating and Assembling	62	19	19	12	43	45	48	0	52
• Plastics Fabricating (SIC 165)	69	0	31	28	0	72	28	0	72
• Plastics Molding (SIC 165)	79	0	21	64	0	36	29	0	71
• Electrical Equipment Installing and Repairing	76	4	20	61	4	35	52	0	48
• Industrial Machinery Mechanics and Repairmen	76	5	19	50	9	41	46	0	54
• Business and Commercial Machine Mechanics and Repairmen (SIC 318)	81	3	16	54	3	43	70	0	30
• Aircraft Mechanics (SIC 321)	25	18	57	25	18	57	25	0	75
• Inspecting and Testing	60	16	24	34	23	43	54	4	42
MATERIALS HANDLING AND RELATED	29	6	65	23	10	67	24	2	74
OTHER, First Mention	62	14	24	2	34	64	55	0	45
OTHER, Second Mention	100	0	0	80	0	20	57	0	43

\+ increase − decrease 0 remain the same
Non-responses excluded.

5.4 Technology Impact on Skill Levels and Job Content

Respondents were asked to rank the impact of new technologies on selected occupations in terms of:

- skills required,
- time to achieve proficiency, and
- knowledge of firms' operations.

The results are summarized in Table 27. Firms were asked to indicate the impact of technology in terms of increase (+), decrease (-) or remain the same (o).

Table 27 suggests a high degree of consensus that technology will increase the skill levels of most occupations. The following notes some categories in which there is a clear consensus across the industries surveyed that manufacturing technology adoptions will require an increase in skills. There was no consensus on a decrease in skills in relation to new technology adoption for any occupations.

Occupations In Which Firms Indicate a Clear Consensus That Skills Will Increase
(i.e., 50% or More of the Firms Indicate an Increase)

Managers and Related
Engineers
Systems Analysts/Programmers
Processing
Machinists
Supervisors/Foremen
Electrical Equipment Fabricating and Assembly
Electronic Equipment Fabricating and Assembly
Plastics Fabricating
Plastics Moulding
Installing and Repairing
Inspecting and Testing

TABLE 28: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Firms' Training Costs
1985-1995

SIC	Industry	Training Costs as a Percent of Labour Costs				Percent of Total Training Costs Related to New Technology				
		Estimated		Expected		Estimated			Expected	
		1984	1985	1990	1995	1981	1984	1985	1990	1995
291	Iron and Steel	2.2	2.2	2.3	2.4	60	80	60	75	75
304	Metal Coating and Stamping Industry	2.1	1.6	2.1	2.2	14	22	25	32	32
306	Hardware, Tool and Cutlery Manufacturing	5.0	5.7	6.2	6.3	10	42	50	53	54
309	Miscellaneous Metal Fabricating Industries	4.9	4.4	4.8	4.8	13	27	34	31	32
315	Miscellaneous Machinery and Equipment Manufacturers	2.1	1.8	2.2	2.3	9	12	13	18	18
318	Office and Store Machinery Manufacturers	5.3	6.1	8.6	9.4	40	41	44	51	51
335	Communications Equipment Manufacturers	2.5	3.0	4.0	4.0	33	32	36	37	38
321	Aircraft and Aircraft Parts Manufacturers	4.1	6.2	6.8	7.3	48	56	60	65	66
165	Plastic/Processing	2.7	5.3	5.9	6.1	25	40	46	55	56
	Average of Reporting Firms	3.7	4.3	5.0	5.2	21	36	40	44	45

There is not as clear a general consensus about the impact of technology on the time required to achieve proficiency. However, "little" impact is probably the dominant theme. Occupations where a clear consensus emerged are listed below.

Increased Time (50% or over)	Decreased Time (50% or over)
Foremen	
Plastics Moulders	Draughtsmen
Electrical Equipment Repairmen	
Industrial Equipment Repairmen	

Few respondents saw technology reducing the need of workers to know and understand the firm's operations. The occupations where increased knowledge of the organization would be required are as follows.

Increased Knowledge (50% or over)
Managers and Related
Engineers
Technicians
Systems Analysts/Programmers
Foremen
Business and Commercial Machine Fabricating and Assembling
Electrical Equipment Installing and Repair

5.5 Training Costs and New Technology

Firms in the selected manufacturing industries currently estimate spending an average of 2% to 5% of their total labour costs on training. Overall, training costs increase the most from 1984 to 1985, with little change expected by 1990 or 1995.

EXHIBIT 11

COMPARISON OF TRAINING COSTS

Industry	Training Costs	Related to New Technology
Iron and Steel	-	+
Metal Stamping, Pressing and Coating	-	-
Hardware, Tool and Cutlery	+	+
Miscellaneous Metal Fabricating	o	-
Miscellaneous Machinery and Equipment	-	-
Office and Store Machinery	+	o
Communications Equipment	-	-
Aircraft and Aircraft Parts	+	+
Plastic Processing	+	+

\+ Higher than average for all industries.

o About average for all industries.

\- Below average for all industries.

When asked to allocate the percentage of total training costs related to new technology, a distinctive trend is evident. That is, in all industries, the percentage of total training costs related to new technology rises from 21% in 1981 to 40% in 1985, to 45% in 1990 and 1995.

The survey results for questions on training are shown in Table 28. As is evident, there is considerable variability by industry.

Exhibit 11, opposite, compares the manufacturing industries investigated to the average of all reporting firms in terms of training costs as a percentage of labour costs, and the percentage of training costs related to new technology, as higher than average (+), about average (o) or below average (-). It suggests that five industries are training 'leaders' relative to the group of manufacturing industries reviewed. They are: Hardware, Tool and Cutlery, Office and Store Machinery, Aircraft and Plastics. Exhibit 11 also shows that four of these industries will be spending more than average portions of their training budgets on new technology. They are: Iron and Steel, Hardware, Tool and Cutlery, Aircraft and Plastics.

TABLE 29: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

SIC	Industry	Union Representation in Firms: Percent of Firms With Union Representation (1)	Of Firms with Union, Percent of Employment Unionized (1): Estimate 1984	Estimate 1985	Expected 1990	Expected 1995
291	Iron and Steel	35	80	80	75	70
304	Metal Coating and Stamping Industry	40	75	80	75	75
306	Hardware, Tool and Cutlery Manufacturing	20	65	60	60	60
309	Miscellaneous Metal Fabricating Industries	65	65	65	65	65
315	Miscellaneous Machinery and Equipment Manufacturers	60	45	35	35	35
318	Office and Store Machinery Manufacturers	25	20	20	15	15
335	Communications Equipment Manufacturers	25	65	65	65	65
321	Aircraft and Aircraft Parts Manufacturers	65	80	80	75	75
165	Plastic Processing	55	80	80	80	80
	Average of Reporting Firms	45	65	65	60	60

(1) Rounded to closest 5%.

6.0 LABOUR RELATIONS ENVIRONMENT

This chapter discusses the survey results for firms and unions regarding the labour relations environment in the selected manufacturing industries.

6.1 Trends in Unionization

The sample firms in the manufacturing industries suggest that approximately 45% of all firms in these industries have a certified union representing a portion of their work forces. The survey results for each industry are shown in Table 29. Of the industries surveyed, the firms most likely to have a union are in Aircraft and Miscellaneous Metal Fabricating (65%), Miscellaneous Machinery (50%) and Plastics (55%). The industries with firms least likely to have a union are Hardware, Tool and Cutlery (20%), Office and Store Machinery (25%) and Communications Equipment (15%).

Of the firms with unions, an average of about 65% of the total employment in these firms is unionized. Firms with a union in which a high proportion of the work force is unionized are Iron and Steel, Plastics, Metal Coating and Stamping and Aircraft. In the Office and Store Machinery industry, about 20% of the firms' work forces are unionized. Generally, firms with unions did not foresee much change in the percentage of their work forces to be unionized over the next ten years.

6.2 Technology Change Clauses

Table 30 shows the percentage of collective agreements, by industry, which have a technology change clause. As a bench mark for comparison, the percentage of firms with a union(s) is also shown. The table also shows the percentage of the technology change clauses with various features (e.g., a notice or disclosure clause).

TABLE 30: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Unions and Technology Change

SIC	Industry	Percent of Firms with a Union (1)	Percent of Contracts with a Technology Change Clause (1)	Percent of Technology Change Clauses Covering (1)					
				Notice	Consult	Job Security	Joint Committee	Seniority	Other
291	Iron and Steel	35	80	100	75	75	0	75	0
304	Metal Coating and Stamping Industry	35	65	40	40	0	0	0	20
306	Hardware, Tool and Cutlery Manufacturing	20	20	100	0	0	0	0	100
309	Miscellaneous Metal Fabricating Industries	65	25	0	0	0	0	50	50
315	Miscellaneous Machinery and Equipment Manufacturers	60	25	100	65	65	0	65	0
318	Office and Store Machinery Manufacturers	25	0	-	-	-	-	-	-
335	Communications Equipment Manufacturers	25	50	60	20	0	0	20	0
321	Aircraft and Aircraft Parts Manufacturers	65	60	90	45	45	65	55	10
165	Plastic Processing	60	35	65	35	65	0	100	35
	Average of Reporting Firms	45	40	70	40	35	15	50	20

(1) Rounded to nearest 5%.

The table suggests that firms with collective agreements in the Iron and Steel (80%), Metal Coating and Stamping (65%), Communications Equipment (50%) and Aircraft (60%) industries are most likely to have a technology change clause. Firms with collective agreements in the Hardware, Tool and Cutlery (20%), Miscellaneous Metal Fabricating (25%), Miscellaneous Machinery (25%) and Office and Store Machinery (0%) industries are the least likely to have technology change clauses.

Table 30 shows the percentage of technology change clauses with common features. The most common feature covered by the technology change clauses is notice/disclosure (70%), followed by seniority (50%). A prior consultation statement is in 40% of the technology change clauses, 35% have a job security statement and 15% of the clauses make provision for a joint labour/management committee(s) on technology introduction.

A high percentage of management in firms (90 %) with technology change clauses answered affirmatively that the clauses are effectively administered. Firms in only three industries had management respondents who indicated that the clauses were not effectively administered.

Union respondents had a different perspective on the effectiveness of the clauses' administration. Using unweighted responses, 75% of the union respondents indicated that the clauses were not effectively administered, while 25% answered affirmatively.

6.3 Management's Perception of Union's Position on New Technology

Management and union respondents were asked an open-ended question on what has been the union's position on the adoption of new technologies.

A high percentage of management responses acknowledged in their statements that the union accepts the need for new technology. In fact, their responses more commonly named union acceptance of new technology (56%) than did the union respondents (44%). In survey research, for an open-ended, unbiased question, these percentages are considered significant.

Only a few management participants (5%) indicated in their responses the theme that, whereas the union membership accepts the need to adopt new technology, the union leadership resists technology change.

The union concerns were also coded from the responses to the question. Management respondents' perceptions of the unions' concerns were, in general, not appreciably different from the perceptions of the union respondents. Both management and union respondents viewed job security as the unions' number one concern. Whereas the union respondents mentioned training as often as job security, management respondents named the impact on union membership as the unions' second greatest concern. Union respondents also cited this concern.

Management also viewed the union as concerned with realizing a share of the benefits of new technology for its members whereas no union respondents named this theme.

Finally, management and union respondents also named control over the technology as an aspect of concern to unions.

6.4 Formal Mechanisms for Worker Participation

Firms and union respondents were asked to indicate whether their firms had a formal mechanism for worker participation in:

- setting production and/or sales targets at various levels in the organization,
- improving productivity/quality, and
- adoption of new technology.

The survey results for all firms, with or without a union(s), by industry, are shown in Table 31. The unweighted union data are provided for comparison purposes although it must be kept in mind that the firm and union data are not directly comparable as: 1) the firm data are weighted and the union data are not; 2) the firm data include firms with and without a union; 3) not all unions in the sample firms participated in the study, and 4) the union sample was never designed to be statistically significant.

However, if the union respondents are somewhat representative of workers' views of such mechanisms and if the unionized and non-unionized firms are not that dissimilar in terms of reporting that formal mechanisms are in place, then the firm and union totals suggest that, generally, management of firms perceive that more formal mechanisms for worker involvement are in place than do the workers.

TABLE 31: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

Formal Mechanisms for Worker Participation (1)

SIC	Industry	Percent of Firms with a Formal Mechanism for Worker Participation in: Setting Production and/or Sales Targets: At Company Level	At Division/ Plant Level	At Department/ Area Level	At Working Group Level	Improving Productivity/ Quality	Adoption of New Technology
291	Iron and Steel	0	0	0	67	100	67
304	Metal Coating and Stamping Industry	5	18	48	58	66	21
306	Hardware, Tool and Cutlery Manufacturing	31	31	50	70	89	50
309	Miscellaneous Metal Fabricating Industries	7	24	18	0	42	24
315	Miscellaneous Machinery and Equipment Manufacturers	0	0	1	31	37	30
318	Office and Store Machinery Manufacturers	56	50	66	50	79	65
335	Communications Equipment Manufacturers	17	17	22	23	56	5
321	Aircraft and Aircraft Parts Manufacturers	15	8	22	21	52	42
165	Plastic Processing	25	31	42	29	71	36
	Average of Reporting: FIRMS (2)	20	22	33	36	62	39

(1) Multiple responses accepted.

(2) Includes firms with or without unions.

EXHIBIT 12

COMPARISON OF FORMAL MECHANISMS FOR WORKER PARTICIPATION

SIC	Industry	Setting Production and/or Sales Targets	Improving Productivity/ Quality	Adoption of New Technology	Overall Rating on Worker Participation
291	Iron and Steel	+	+	+	+
304	Metal Stamping, Pressing and Coating	+	+	-	+
306	Hardware, Tool and Cutlery	+	+	+	+
309	Miscellaneous Metal Fabricating	-	-	-	-
315	Miscellaneous Machinery and Equipment	-	-	-	-
318	Office and Store Machinery	+	+	+	+
335	Communications Equipment	-	-	-	-
321	Aircraft and Aircraft Parts	-	-	o	-
165	Plastics Fabricating	+	+	-	+

+ Above average for all reporting manufacturing firms
o About average for all reporting manufacturing firms
- Below average for all reporting manufacturing firms

Exhibit 12, compares the firms' responses by industry as above (+), below (-) or about average (o) in terms of the reported incidence of formal mechanisms relative to the average for all firms surveyed. It also rates each industry overall in terms of reported mechanisms for worker participation as above or below average. Firms in the Miscellaneous Metal Fabricating, Miscellaneous Machinery, Communications Equipment and Aircraft industries have the lowest reported incidence of worker participation mechanisms.

In terms of production targets, firms in the following industries are reported most likely to have formal mechanisms at some level in the organization.

- Metal Coating and Stamping,
- Hardware, Tool and Cutlery, and
- Office and Store Machinery.

In terms of improving productivity or quality, firms in the following industries are reported most likely to have a formal mechanism.

- Iron and Steel (100%),
- Metal Coating and Stamping (66%),
- Hardware, Tool and Cutlery (89%),
- Office and Store Machinery (79%), and
- Plastics (71%).

In terms of technology adoption, firms in the following industries are reported most likely to have a formal mechanism.

- Iron and Steel (67%),
- Hardware, Tool and Cutlery (50%), and
- Office and Store Machinery (65%).

6.5 Views on Involving Workers in Decisions on Adopting New Technology

Respondents were asked an open-ended question as to what extent and how management should involve workers in decisions on adopting new technology. The responses of firms, without or with a union, are shown in Table 32, by industry. Also provided for comparison are the total unweighted results of all union respondents to the same question. The types of responses are arranged roughly in a continuum from 'full' involvement to 'no' involvement. The totals of firm and union responses, by type of response, are relatively close, with one exception. Twenty-one percent (21%) of the firm responses saw no need for worker involvement in decisions on adopting new technology whereas only seven percent (7%) of the unions saw no need for involvement.

Sample firms in Office and Store Machinery indicated favouring the highest degree of involvement/consultation and sample firms in Communications Equipment the lowest.

Several cautionary notes should be applied in reviewing Table 32.

1. The survey results show how specific managers in a sample of firms in each industry feel about worker involvement. It does not indicate how firms act.

2. Table 32 may mask how individual firms within a single industry view worker involvement.

3. The results should not be viewed as statistically significant for this question because the sample of firms in any one industry was relatively small and not all respondents provided an answer to this question. Furthermore, the sample and sample frame was structured by employment size, not firms' attitudes toward industrial labour relations.

TABLE 32: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

To What Extent and How Should Management Involve Workers In Decisions on Adopting New Technology? (1)

(Percent of Firms)

SIC	Industry	Full Involvement	Prior Consultation	Advance Notice	Discussion (Limited Dialogue)	Explanation Re Job Security	Explanation Regarding Training	Information Only	No Involvement
291	Iron and Steel	33	0	0	0	0	33	67	33
304	Metal Coating and Stamping Industry	20	30	0	5	11	5	11	29
306	Hardware, Tool and Cutlery Manufacturing	21	26	0	21	5	0	42	5
309	Miscellaneous Metal Fabricating Industries	36	0	0	0	17	0	17	29
315	Miscellaneous Machinery and Equipment Manufacturers	16	63	0	0	0	15	0	24
318	Office and Store Machinery Manufacturers	32	42	26	0	0	0	26	0
335	Communications Equipment Manufacturers	6	19	0	6	13	6	27	57
321	Aircraft and Aircraft Parts Manufacturers	9	45	0	12	12	25	0	9
165	Plastic/Processing	27	13	28	33	14	13	41	6
	Average of Reporting:								
	FIRMS (2)	23	26	6	10	9	10	25	21

(1) Multiple responses accepted.

(2) Includes all firms, with unions and without unions.

6.6 Conclusion

About 45% of the firms surveyed had a union. Of the unionized firms, few expected any changes in the percent of their work forces which are currently unionized. If any change is anticipated, a decrease is expected. Non-unionized firms did not generally foresee unions being organized in their firms.

On average, for the firms with a union(s), only about 40% of the collective agreements have a technology change clause. These clauses most frequently cover notice (70%), seniority (50%), and prior consultation (40%). Firm and union respondents differed appreciably on their perceptions of how effectively the technology change clauses are being administered.

Management in most unionized firms perceives the union as accepting the need for technology change. They perceive that the unions' main concerns with technology change are job security and its impact on their membership. The unions perceive job security and training as their most important concerns.

Firms sampled in the Office and Store Machinery industry consistently appeared to be the most progressive in their industrial relations in terms of formal mechanisms for worker participation and the degree of consultation which firms believe is appropriate in deciding on and implementing new technology. Firms sampled in the Communications Equipment industry tended to be the least progressive.

Over 35% of all firms report having some type of formal mechanism for worker involvement in setting production targets. Over 60% have such a mechanism for improving productivity/quality, and nearly 40% report such a mechanism for worker involvement in adopting new technologies.

Firms are split on their approach to involving workers in decisions on adopting new technology. For example, whereas 23% of firms feel full involvement is appropriate, 21% feel no involvement is warranted.

TABLE 33: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

SIC	Industry	Planning for Technological Change: Strategic Plan — Percent of Firms With Plan	Human Resource Plan — Percent of Firms With Plan	Human Resource Plan — Length of Planning Horizon (1)	Capital Investment Plan — Percent of Firms With Plan	Capital Investment Plan — Length of Planning Horizon (1)	Perceived Integration Between Capital and Human Plans (2)
				(Years)		(Years)	
291	Iron and Steel	100	67	5	100	5	3.7
304	Metal Coating and Stamping Industry	70	25	4	58	4	2.0
306	Hardware, Tool and Cutlery Manufacturing	50	50	4	65	4	3.8
309	Miscellaneous Metal Fabricating Industries	71	7	3	30	2	1.2
315	Miscellaneous Machinery and Equipment Manufacturers	63	39	5	53	5	2.3
318	Office and Store Machinery Manufacturers	58	58	5	36	3	2.5
335	Communications Equipment Manufacturers	61	37	5	49	4	3.2
321	Aircraft and Aircraft Parts Manufacturers	56	41	4	52	4	2.7
165	Plastic Processing	43	62	3	61	4	2.5
	Average of Reporting Firms	62	42	4	56	4	2.6

(1) Counts 1984-1985 as one year.
(2) Using a scale of 1 to 5: 1 represents "Not at all integrated" and 5 "Highly integrated".

7.0 PLANNING FOR TECHNOLOGICAL CHANGE

The final chapter reports the results of the survey regarding questions related to planning for technology change. Table 33 summarizes the results.

7.1 Long-Term Strategic Plan

Over 60% of the firms surveyed report having a long-term strategic plan. The firms most likely to have a plan are in the Iron and Steel (100%), Metal Coating and Stamping (70%), Miscellaneous Metal Fabricating (71%) and Miscellaneous Machinery (63%) industries. The firms least likely to have a plan are in the Plastics industry (43%).

7.2 Human Resource Plan

Over 40% of the firms report having a human resource plan. The average length of the planning horizon is four years.

Firms most likely to have a plan are in the Iron and Steel (67%), Office and Store Machinery (58%), Plastics (62%) and Hardware, Tool and Cutlery (50%) industries. Firms in Miscellaneous Metal Fabricating (7%), Metal Coating and Stamping (25%), Communications Equipment (37%), Miscellaneous Machinery and Equipment (39%) and Aircraft (41%) industries are least likely to have a human resource plan.

EXHIBIT 13

COMPARISON OF PLANNING CAPABILITY

Industry	Strategic Plan	Human Resource Plan	Capital Plan	Capital Investment Integration	Overall Rating of Planning Capability
Iron and Steel	+	+	+	+	Strong
Metal Stamping, Pressing and Coating	+	-	o	-	Mixed
Hardware, Tool and Cutlery	-	+	+	+	Fair
Miscellaneous Metal Fabricating	+	-	-	-	Weak
Miscellaneous Machinery and Equipment	o	-	o	-	Weak
Office and Store Machinery	o	+	-	o	Modest
Communications Equipment	o	-	-	+	Weak
Aircraft and Aircraft Parts	-	o	o	o	Weak
Plastic Processing	-	+	+	o	Modest

+ Above average

o About average

- Below average

7.3 Capital Investment Plan

Well over half of all firms indicate having a capital investment plan with an average four-year planning horizon. Firms most likely to have a capital investment plan are in the Iron and Steel (100%), Hardware, Tool and Cutlery (65%), and Plastics industries (61%). Firms least likely to have capital plans are in the Miscellaneous Metal Fabricating (30%), Office and Store Machinery (36%) and Communications Equipment (49%) industries.

7.4 Perceived Integration Between Capital and Human Resource Plans

Firms generally acknowledge a very low level of integration between their capital investment and human resource plans. Firms were asked to rate the degree of integration between their resource and capital plans on a scale of 1 - "not at all integrated", to 5 "highly integrated". Therefore, a rating of 3, in the middle of the scale, would represent a fair degree of integration. Only two industries report high levels of integration, Iron and Steel and Hardware Tool and Cutlery. In only one other industry - Communications Equipment, did firms rate their plans as fairly well integrated. However, firms surveyed in this specific industry were below average in terms of having plans.

7.5 Conclusion

Exhibit 13, opposite, summarizes the planning capability of the firms in each industry as above (+), below (-) or about average (o), relative to the average for all manufacturing industries surveyed on the questions asked, and rates each in terms of its overall planning capability. Only one industry received a strong overall rating - Iron and Steel.

FIRM EMPLOYMENT SIZE CATEGORIES USED IN THE SURVEY OF SELECTED MANUFACTURING INDUSTRIES

FIRM EMPLOYMENT SIZE CATEGORIES USED IN THE SURVEY OF SELECTED MANUFACTURING INDUSTRIES

Size Categories Used to Stratify the Sample Frame	Size Categories Used to Weight and Report Survey Results	
Number of Employees		Number of Employees
20 - 49	Small	20 - 99
50 - 99		
100 - 199	Medium	100 - 499
200 - 499		
500 - 999	Large	500 or more
1000 - 1499		
1500 - 2499		
2500 - 4999		
5000 or more		

APPENDIX B

RELIABILITY OF THE SAMPLE

SAMPLE RELIABILITY

The sample reliability is summarized with other sample and population characteristics in "Table 1". The sample was selected as a three stage stratified random sample. The purpose of this stratification was to reduce the error variance in the measurement of organization size by increasing the homogeneity of each group of organizations within each strata.

The first stage consisted in creating two industry sectors (i.e. manufacturing and services). The second stage involved dividing up each industry sector into nine and fourteen industrial sub-classes respectively and according to Standard Industrial Classification codes (see Table 1). The third stage was to further stratify each SIC into three more homogeneous size groups:

Manufacturing Sector		Service Sector
Small	20- 99 employees	20-199 employees
Medium	100-499 employees	200-999 employees
Large	500+ employees	1,000+ employees

Exceptions to these three size groupings are as follows:

SECTOR		ORGANIZATION SIZE EXCLUSION
Manufacturing Sector		
291	Iron & Steel Mills	less than 500
321	Aircraft & Aircraft Parts	less than 50
Service Sector		
701	Banks and Trusts	less than 50
721	General and Life Insurance	less than 50
735	Insurance Brokers	less than 50
909	Federal Government	less than 500
931	Provincial Government	less than 200
951	Local Government	less than 500

Overall, the sample yields a relatively high reliability level in reflecting the employment level of those sectors surveyed. For instance, the manufacturing sector samples generally yield a minimum confidence level of about 99 percent with an associated allowable error of 5 percent. That is, we would expect that the estimated employment level for the sector has a 99 percent chance of being within $\pm$ 5 percent of the actual employment level found in the frame. Or stated alternatively, if 100 independent random samples were drawn, in 99 of these samples we would expect to have an estimated employment level within $\pm$ 5 percent of the actual employment level found in the sample frame.

Table 1 suggests a worse case scenario of 90 percent reliability with associated allowable error of 23 percent in SIC 291-Iron & Steel Mills. Though the total reported employment level within the sample reflects a very significant coverage of the employment level within the industry, the great variability in employment level contributes to a high level of variance in the employment level and thus reduced reliability and associated tolerance.

TABLE 1: SUMMARY - SELECTED MANUFACTURING INDUSTRIES

		SAMPLE FRAME AND SAMPLE									
		UNIVERSE		SAMPLE FRAME				SAMPLE			
SIC Code	SIC NAME	Number of Firms	Number of[1] Employees	Firm Size Cut Off	Number of Firms	Number of[2] Employees	Share of Universe	Number of Firms	Number of Unions	Number of[3] Employees	Reliability Level (min.
291	Iron and Steel Mills	17	41,603	500	7	39,900	96	3	1	21,833	90
304	Metal Stamping, Pressing and Coating Industry	185	17,730	20	145	17,200	97	14	3	4,507	99
306	Hardware, Tool and Cutlery Manufacturing	225	12,826	20	135	11,500	90	11	6	1,489	94
309	Miscellaneous Metal Fabricating Industries	132	12,235	20	110	12,000	98	11	6	2,694	99
315	Miscellaneous Machinery and Equipment Manufacturers	304	36,904	20	262	36,500	99	12	3	3,972	99
318	Office and Store Machinery Manufacturers	29	10,485	20	29	9,800	93	7	0	11,814	99
335	Communications Equipment Manufacturers	67	28,090	20	65	27,800	99	12	2	14,946	90
321	Aircraft and Aircraft Parts Manufacturers	22	12,732	50	17	12,000	94	10	5	11,737	95
165	Plastic Processing	196	19,218	20	169	18,800	98	13	4	2,400	99

(1) Source: Census of Manufacturing, 1982, Statistics Canada, Catalogue No. 31-203.

(2) Rounded to nearest 100.

(3) Sum of firms' estimates for 1984, rounded to nearest 100.

FINAL REPORT AND APPENDICES OF THE ONTARIO TASK FORCE ON EMPLOYMENT AND NEW TECHNOLOGY

Final Report — Employment and New Technology

Appendices:

1. Labour Market Trends in Ontario, 1950-1980
2. Occupational Employment Trends in Ontario, 1971-1981
3. Emerging New Technology, 1985-95: Framework for a Survey of Firms
4. Employment and New Technology in Ontario's Manufacturing Sector: A Summary of Selected Industries
5. Employment and New Technology in the Iron and Steel Industry
6. Employment and New Technology in the Metal Fabricating Industry
7. Employment and New Technology in the Machinery and Equipment Industry
8. Employment and New Technology in the Aircraft and Aircraft Parts Industry
9. Employment and New Technology in the Communications Equipment Industry
10. Employment and New Technology in the Office, Store and Business Machine Industry
11. Employment and New Technology in the Plastic Processing Industry
12. Employment and New Technology in Ontario's Service Sector: A Summary of Selected Industries
13. Employment and New Technology in the Chartered Banks and Trust Industry
14. Employment and New Technology in the Insurance Industry
15. Employment and New Technology in the Government Services Industry
16. Employment and New Technology in the Telecommunications Industry
17. Employment and New Technology in the Retail Trade Industry
18. Employment and New Technology in the Computer Services and Management Consulting Industry
19. Industry-Sector and Occupational Employment in Ontario, 1985-1995
20. Technological Change, Productivity, and Employment: Studies of the Overall Economy


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